THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 49. Thursday, November 16, 1933. No. 900.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of
THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The Registered Office and Laboratories of the B.C.I.R.A. at:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1885. Telegrams: CIRA.

The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*).

Forthcoming Events.

NOVEMBER 24.

Manchester Association of Engineers:—Meeting, at 7.15 p.m. "The Technique of Heavy Forging," Paper by Capt. R. Benson.

NOVEMBER 30.

Institute of Metals (Birmingham Local Section):—Symposium on Defects in Cold-working. Arranged by A. L. Molineaux.

Institute of British Foundrymen.

NOVEMBER 24.

Birmingham, Coventry and West Midlands Branch:—Meeting at Birmingham, at 7.30 p.m. "Fettling-Shop Efficiency," Paper by W. G. Morgan.

NOVEMBER 25.

Newcastle-upon-Tyne and District Branch:—Meeting, at 6.15 p.m. "Balancing the Elements," Paper by F. J. Cook.

DECEMBER 2.

Scottish Branch (Edinburgh Section):—Meeting, at 4 p.m. "Design, Patternmaking and Moulding: Competitive Methods of Production," Paper by M. Russell.
Wales and Monmouth Branch:—Meeting at Cardiff, at 6.30 p.m. "Test-Bars from the Foundryman's Point of View," Paper by S. Southcott.

Books for Students.

His Majesty the King, by opening the National Central Library in Bloomsbury on November 7, set the seal on an enterprise which dates back to 1916. The Library was founded as the Central Library for Students for the purpose of supplying books otherwise unobtainable to students throughout the country. Its scope has been extended, so that it acts not only as a lending library in itself, but as a medium of exchange between libraries of all kinds in this country and abroad. Any serious reader is regarded as a student for the purpose of this institution, and all those in the foundry industry, as citizens and students, are eligible to share in the advantages it offers. There is no need to enlarge on the limitations of the ordinary public libraries, in which the bulk of the shelves is loaded with fiction and other ephemeral works, and which are limited by the proceeds of a fixed rate in the area they serve; the smaller the area, therefore, the smaller is the stock of books available, and for the purpose of the serious student their value is very small. The National Central Library will lend from its own stock non-fiction works published at no less than 8s. There is no restriction as to subjects, but set text books required for examinations are excluded. Through its contacts with other libraries it will supply highly specialised or expensive books, or scarce and out-of-print books, or foreign books and periodicals. The National Central Library has established contact with 130 libraries throughout the country, the stocks of which can be borrowed through the Central Library. We understand that a loan is usually effected through the local library in the area in which the student resides.

Libraries in a given area are grouped regionally, so that requirements which cannot be met by one local library will be met by another without necessarily calling on the Central Library It is estimated that the Central Library can call on something like five million volumes.

The country is greatly indebted to the Carnegie United Kingdom Trustees, not only for their consistent financial support of this project since its inception, but also for the magnificent building, which cost about £50,000, in which the library is now housed.

We believe that the above facts cannot be too widely broadcast in the industry, so that those students who would like to get books, but who are unable to do so by virtue of price, lack of local facilities, or other causes, can now have their needs met.

Trade Revival.

We have previously stated that the business trend of the foundry industry follows very closely the iron and steel industry, because it is a large customer of the blast furnaces and where the products of the steel rolling mills are being used in increasing quantities, so too are castings. If it be rails, then chairs are required; if it be sheets for motor-car bodies, then cylinder blocks are needed; whilst if it be sections for the construction of buildings, then there is necessarily a demand for rain-water goods, and so on. The manufacture of steel needs coal and coke, and the mines, too, are large consumers of castings.

Nobody is more competent to speak for the iron and steel industry than Sir William Larke, the director of the National Federation of Iron and Steel Manufacturers, and his views are summarised in a statement he made to the Press last week-end: "From the experience of the iron and steel industry during recent months I am satisfied," said Sir William Larke, "that there are grounds for reasoned optimism that the upward tendency in industrial production and employment will continue. The iron and steel industry, being basic in character, may be accepted as an index of the general industrial position. During the first nine months of the present year, as compared with the first nine months of 1932, steel production in the United Kingdom showed an increase of 27 per cent. The Continental producing countries during the same period showed an increase of 17.6 per cent., thus indicating that the upward tendency, if not world-wide, is at least operating over a very wide industrial area. This, I believe, is due in the first instance to the necessity for replenishing world stocks which had become exhausted during the prolonged depression. As a result of this demand, price levels have become firmer, with an upward tendency. This has stimulated new enterprise, desirous of taking advantage of the present low level of prices, which is probably lower to-day than is likely to be seen for many years to come."

As but small stocks of castings are ever held, the repercussion on the foundry industry has been spontaneous, and already buyers are inclined for certain types of castings to offer a little extra premium for quick delivery. It is pleasing to note that even the foundries catering for shipbuilding and cotton textiles are at last feeling the improvement.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Blaming the Refractories.

To the Editor of The Foundry Trade Journal.

Sir,—I am glad to see in your issue of October 12 that you draw the attention of the users of refractory materials to the many factors outside the materials themselves which affect, and in some cases shorten, their useful life in the furnace.

In particular I notice the opinion you express as to the need "for a plain statement by some co-operative organisation within the refractories industry which would list types of refractories, their relative cost and their properties as to refractoriness, expansion, abrasion and slag resistance, heat insulation and the like."

As you are possibly aware, the British Refractories Research Association, in conjunction with the Iron and Steel Federation, has set up two joint committees, one dealing with blast-furnace refractories and the other dealing with open-hearth and steelworks refractories.

A considerable volume of work has already been published in the Bulletin of the Research Association and also in the form of special reports issued by the Iron and Steel Federation. These give in considerable detail information on the points to which your paragraph refers.

I can assure you that the British Refractories Research Association will be only too glad to co-operate with any body of users of refractories with a view to assisting them to select the most suitable type of refractory material for whatever purpose, or for whatever type of furnace they may have in contemplation.

As you are doubtless fully aware, research work on refractories is very expensive, and takes a good deal of time to carry through, and the ultimate benefits resulting from it in the shape of longer life of furnaces and larger output are to the advantage of the consumers rather than the makers of refractories.

I am quite sure that a little thought will convince your readers that co-operation in this work in the shape of subscriptions to the British Refractories Research Association, enabling the programme of research to be further extended, will bring ample returns in the shape of decreased cost of refractories per ton of metal produced.

Any inquiries, either to the Secretary, Drayton House, 30, Gordon Street, London, W.C.1, or to the Director of Research, Dr. J. W. Mellor, F.R.S., North Staffordshire Technical College, Stoke-on-Trent, will receive every attention.—Yours, etc.,

C. W. Thomas, Chairman.

The British Refractories Research Association,
Drayton House, 30, Gordon Street,
London, W.C.1,
November 6, 1933.

Impact Tests on Steel Castings.

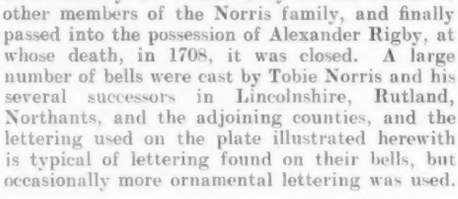
Because of the increasing interest in impact values of steel castings, a committee has been appointed by Mr. F. A. Melmoth, Chairman of the Steel Division of the American Foundrymen's Association, to make a survey of the present methods of tests and to present recommendations as to methods which should be followed.

This committee held its first meeting at Detroit on October 3, under the chairmanship of Mr. Fred Grotts, of the Continental Roll & Steel Foundry Company, East Chicago, Ind.

The committee plans to secure information and data from all steel foundries, which are at present making impact tests, then determine which procedure is most practicable for use in shop laboratories. It is expected that a report will be presented at the 1934 Convention.

A Bellfounder's Memorial.

At St. George's Church, Stamford, Lincs, is a memorial plate of bell-metal (cast in his own foundry) to Tobie Norris, Bellfounder, who established a bellfoundry at Stamford about 1603. This foundry was successively in the hands of other members of the Norris family, and finally passed into the possession of Alexander Rigby, at whose death, in 1708, it was closed. A large number of bells were cast by Tobie Norris and his several successors in Lincolnshire, Rutland, Northants, and the adjoining counties, and the lettering used on the plate illustrated herewith is typical of lettering found on their bells, but occasionally more ornamental lettering was used.



Memorial Plate to Tobie Norris, the Famous Bell-Founder.

Although their bells were well in evidence locally, when they went farther afield they did not always meet with approval, if any reliance is to be placed on Rudhall's gibe (at Rigby's work) at Badgworth, Glos, where a bell (presumably a re-casting of one from the Stamford Foundry) bears the following:—

"Badgworth Ringers they were mad
Because Rigbie made me bad
But Abel Rudhall you may see
Hath made me better than Rigbie."
1742

Be that as it may, the fact remains that quite a number of good bells were cast by the Norris family and many of them are still in regular service.

Notes from I.B.F. Branches.

Lancashire Junior Section. — At the opening meeting, held in the Manchester College of Technology on October 28, Mr. R. A. Jones, the chairman, after thanking the members for his re-election, said that with the decrease of the jobbing shop and the increase of the mechanised foundry, the Junior Section was becoming of more importance each year to those young foundrymen who wished to study their trade. He also appealed to all persons in executive positions to try and persuade all the boys they came in contact with to attend the Junior Section. Mr. Jones then presented the following prizes won during the 1932-33 session:—Mr. B. Haigh, "John Wilkinson" Medal; Mr. C. Sutcliffe, second place, Book Prize; and Mr. O. Bateson, winner of Short Paper Contest, Book Prize.

Mr. F. Griffiths, of Rochdale, then read a Paper on "The Manufacture of Iron Castings for Enamelling and Galvanising," who enunciated the main essentials to secure castings fit for this work, as (1) successful design, even section as far as possible, elimination of all thick sections and bosses; (2) that the castings should be machine-moulded, the patterns, as far as possible, being of metal, the moulds not being touched up by the trowel; (3) that a fine, strong, permeable sand be used, as few vents as possible and as few irons and gaggers also as possible. The sand should be under strict control and supervision all the time; and (4) that good metal is necessary, casting for enamelling must be as gas free as possible.

Random Shots.

A move has at last been made towards brighter company meetings for shareholders. Consider, for a moment, "Marksman's" own experience. For years he has attended the annual meeting of a foundry company in which he holds two dozen 5⅔ per cent. 4th mort. deb. red. def. non-cum. pref. ord. A shares (fly. pd.). An important block, you see; and it behoves "Marksman" to look after his interests—and interest—very carefully. But the meeting proceeds so uneventfully that after ten minutes he is lulled to sleep by the mellifluous notes of a chairman in song; and to learn anything of subsequent proceedings he has to buy a copy of the morrow's morn's financial newspaper. This type of company meeting is not without its advantages. A friend of "Marksman," for example, suffers periodically from insomnia; two company meetings, taken in the morning at the Cannon Street Hotel, cure him of the worst attack. On the other hand, a second friend, a normal, healthy business man, contracted sleeping sickness through subjecting himself to the same treatment.

* * *

The brightest company meeting which "Marksman" could imagine would be the one at which a 33⅓ per cent. dividend, free of tax, is declared.

* * *

The innovation in company meeting procedure which launched "Marksman" on this theme has been made by a Birmingham engineering firm. They have arranged to exhibit at their own meeting a number of talking films illustrating the various processes of manufacture carried on in their works. What an excellent way of educating the shareholder! (And if the idea be generally adopted what a boon there will be in textile (lingerie) shares!)

* * *

Or, again, what an excellent opportunity is the shareholder given to criticise the manufacturing processes of a concern in which his money is invested. One can imagine an irate foundryman rising to his feet and protesting that the whole of the plant in Messrs. Blogg's foundry department, as shown on the screen, is out of date, and what do the management mean by allowing antique equipment to stand in the way of increased dividends? . . .

* * *

S.O.S.

Missing from the Gayway Foundry, Eastbourne, since 31st ult., Miss Nellie Snookers, height 5 ft. 0 in., ash-blonde hair, blue eyes; when last seen was wearing balloonist's kit for stratosphere ascent. Will any person having any knowledge of her whereabouts please communicate with "Marksman" at the Gayway Foundry?

* * *

Two knights of the road were walking along the railroad tracks and found a bottle of whisky. One took a drink and passed it to the other. And so forth until the bottle was empty.

After a while one puffed out his chest and said, "You know, Bill, to-morrow I'm going to buy this railroad. I'm going to buy all the railroads in the country, all the automobiles, all the steamships—everything. What do you think of that?"

Bill looked at his companion disparagingly and replied, "Impossible, can't do it."

"Why not?"

"I won't sell!"

Marksman.

Technical Control of Small Foundries.

The East Midlands Branch of the Institute of British Foundrymen held a meeting at the Derby Technical College on October 28, 1933, when a lecture was given by Mr. J. G. Pearce, M.Sc., Director of the British Cast Iron Research Association, on "The Technical Control of the Small Foundry." In the course of his address Mr. Pearce referred to the debate on "Science and Practice" given before the Branch last session, and he said, reading between the lines, both speakers had their tongues between their cheeks. It appeared they had both been more intent in "making a case" than saying what they really thought. The real situation could be summed up in the Institute's motto "Science Hand in Hand with Labour." The union of the two was essential. Life was too short for a man to be equally well trained in both spheres, but a man of the right calibre could absorb sufficient of each to be suitable. The real danger came from the chemist, who had no sympathy for the practical side, and from the practical man who had disregard of "book" learning.

What was the best way of starting technical control in the small foundry? It must be on an economic basis. The cost of the wages for the control must be less than the cost of the loss on waster castings, including loss due to delays and the loss of prestige. He did not necessarily recommend the chemist as the man for such control. Analysis required a good deal of interpretation. It would be better to employ the young man as assistant to the foundry manager, who could be responsible for the quality of the raw materials, mixtures, melting and sands.

Why was such control necessary? Some years ago blast-furnace pig-irons were fairly uniform and the fracture did show something to the founder; but to-day, fracture as a means of silicon control was more or less obsolete. The fracture of pig-irons was governed entirely by the size and quantity of the graphite. In a section there are the openness or closeness of the grain, and the colour of the grain. The openness was governed by the size of the graphite, and colour was governed by the quantity. It was common practice when wanting more open-grained metal to melt a larger proportion of open-grained pig-iron. In re-melting iron, the cupola was unable to furnish either the time or the temperature to send all graphite into solution. There were, therefore, particles of undissolved graphite, forming nuclei.

Mr. Pearce then referred to the variations of silicon content in one part of a consignment to another. A constant fracture did not mean a constant silicon content. Fracture summed up the whole of the composition of the metal. For his address that evening he did not intend to take into consideration the effect of phosphorus, manganese or sulphur. The fact was that fracture summed up composition and was mainly governed by the carbon and silicon. Fracture of pig-iron could remain the same when the silicon was altered if the carbon altered with it. A given iron picked up or tended to pick up a certain amount of carbon, the eutectic figure. If the carbon was in excess of that amount, such excess was in the form of Kish and was better out of the iron. Iron on re-melting would tend to form a eutectic iron, and if re-melted often enough would actually reach the eutectic figure. Eutectic dropped one point of carbon for every 0.3 per cent. of a point of silicon added.

Mr. Pearce illustrated by lantern slides that pig-iron with a No. 4 fracture could have silicon content over a wide range, 4 per cent., and a No. 1 fracture over an equally wide range. About 0.3 per cent. of carbon with the same silicon made the difference between a No. 1 and a No. 4 fracture. Another slide illustrated the fracture of a No. 4 hot-blast iron compared to a No. 4 cold-blast iron, which revealed that a cold-blast iron of the same carbon had a lower silicon than the hot blast. The next chart dealt with the variations of carbon content at different points of one pig and it was noted that a variation of 0.2 per cent. carbon was not unusual. These points, said Mr. Pearce, illustrated the difficulties if one tried to judge silicon content by fracture. The properties of cast iron were not entirely influenced by the analysis of the metal. Fracture could be altered very materially without altering the analysis. This could be summed up in "Melting Conditions."

What could be done in a simple way to control these points? One of the simplest was to adopt the chill test. The fracture summed up the composition, particularly as regards silicon and carbon, and could be judged by the chill test. Fracture for purchasing pig-iron to control silicon was now inadequate, but the chill test in the foundry summed up both silicon and total carbon. The test was easily taken, and gave results in time to make a change before casting moulds. Mr. Pearce illustrated the chill mould for the wedge test. The test-piece could be quenched and broken, and experience would give indications of the metal quality. Mr. Pearce then illustrated the spiral runner test-piece for a fluidity test.

In conclusion, Mr. Pearce said, for exercising technical control in the small foundry, he would suggest the appointment of a keen, young man to assist the manager or foreman, and to be put in charge of the raw materials, metal and mixtures. With simple tests one could begin to control the metal in such a way as to draw attention as soon as anything went wrong, and before the metal was poured into the moulds. In larger works that employed their own laboratory staff, these simple tests could be very useful in assisting the results of the laboratory.

DISCUSSION.

The Branch-President (Mr. P. A. Russell) thanked Mr. Pearce for his illuminating address, and left the matter for open discussion by the members present.

Mr. A. E. Peace said, when he saw the first few slides, he was beginning to wonder how foundrymen were able successfully to produce castings. To see the astounding variations to be obtained with similar composition led one to think there must be something else behind this business. One point in connection with hereditary properties; Mr. Pearce suggested the time largely explained that in cupola melting, as graphite did not go into complete solution. There was no disputing on that point at all, but he (Mr. Peace) thought there were properties possessed by pig-irons that repeated themselves despite graphite going into solution. With regard to the fluidity and chill tests, he (Mr. Peace) had found them very useful, and no matter how excellent the laboratory may be, those tests were useful. In his business he used the chill test regularly, and the fluidity test frequently. The suggestion made by Mr. Pearce that the chemist should be "assistant" to the foundry manager was excellent.

Mr. T. Goodwin referred to the question of science and practice. The chemist, in his opinion, was indispensable to-day. Some small foundries were compelled to manage without on account of the cost, but anyone who could afford the chemist should have one, but, with apologies to all chemists, he would say they were sometimes a nuisance. They had a little bit too much importance attached to their name or training. He instanced a case where the chemist was so stubborn that he would not alter an analysis, although the metal was producing undesired chill, and was so obsessed with his own knowledge that he would not alter until told to do so by the managing director. Referring to pig-iron fractures, Mr. Goodwin said, in his younger days, he was employed for a period by a firm of ironmasters. In those days the chemist was unknown, and pig-iron sold was judged by fracture, and it was very rare that the man judging it made a mistake. To-day, there were methods of melting where the carbon could be changed. Carbon had the greatest effect on strength, especially tensile, and he was referring to the rotary furnace. Mr. Pearce had said he would rather melt poor iron in a good furnace than *vice versa*. He (Mr. Goodwin) would ask, what was poor iron?

Mr. Pearce, in reply, thanked Mr. Peace for his general agreement. He agreed that the graphite did not explain all regarding hereditary properties. He was very interested in Mr. Goodwin's remarks. He thought some of the differences between laboratory and foundry were more personal than technical, and when he suggested the employment of the young man in the foundry, if he could take analyses, he did not think he should so fill up his time. Analysis was a full-time job. If one could not afford to have much analysis done, it was better to send it out, and even then you would get difficulties in the differences given by different chemists on the same sample. On the question of new methods of melting, he was principally talking to the small foundry who had only the cupola to melt, and he agreed the new methods altered the graphite problem. He would like to mention that properties could be improved in two ways:—(1) By reducing the graphite in quantity, and (2) by reducing the graphite in size. In his opinion, we were not taking sufficient steps in reducing graphite size. He was sorry he had used the term "poor iron." Poor iron was one that was unsuited to the purpose for which it was used. The same iron might be quite suitable for another job.

Mr. Lucas congratulated the lecturer for one of the best lectures he had heard. He would ask one or two questions. Suppose one took drillings for analysis of a No. 4 pig-iron and drillings from a casting; the drillings from the former were fine and powdery and the latter coarse. What did that imply? If one went to the machine shop and crushed drillings in the hands, it would be noted that some drillings left the hands more dirty than others. What did that imply? If one were using the chill test repeatedly with the same chill mould, the mould would get warmer and warmer. Did that temperature of the mould affect the depth of chill on the test-piece, He expressed surprise that Mr. Pearce had not referred to the "Keeps test." He had used it for years, and he could tell the silicon content almost accurately.

Mr. Pearce said that the closer a cast iron gets to steel the longer would be the turnings. In other words, the lower the carbon the longer the turnings, but that applied if one was reducing the carbon. If one merely reduced size of the flakes, and had more of them, the turnings would break off short. When graphite came off on to the hands, it did so when the graphite was in a fine condition; in larger flakes the graphite would not readily come off. There was a good deal of controversy as to the influence of temperature of the chill mould. Some said it effected the chill and others not, and they were both right. Conditions in one case are not present in another. For the chill test, he recommended a mould temperature of 60 deg. Fah., just warm enough to keep away moisture. He had not mentioned the Keeps test, as in his experience that test failed for the same reason that ordinary fracture of pig failed. It was used to govern silicon in the metal, but led one very much astray if the carbon was changed. One really must be in a position to sum up the joint effect of carbon and silicon. Carbon was as important as silicon. The Keeps test was not so satisfactory as a chill test.

Mr. Measures, referring to the chill test, asked for details of the pouring temperature.

Mr. Pearce replied that that was another controversial point. One would think if one poured hot metal in the chill, the mass of the metal with the temperature range it had to fall through, would

warm up the chill. He did not think temperature of the chill or temperature of pouring had much effect on the depth of chill, under the conditions of the test suggested.

Mr. Bunting said the lecturer had referred to the debate on science and practice, of which he was one of the victims. Mr. Pearce had put before the meeting certain things that still made it essential for the practical man's tests. There was room for both chemist and practical man, provided they did not undertake what they did not understand. Could Mr. Pearce explain how he would get technical control successfully if he was using what he (Mr. Bunting) termed "saucepan hematite," made from salmon tins and the like in the blast furnace, and the foundry's way to judge was by fracture? It was nice to have sections of standard pigs that did not vary to a great extent. The salmon-tin irons were, in his opinion, "bad" irons. If the foundry was running all rough stuff, it did not matter, but for better-quality castings it was very difficult to use these irons; that was what some of the small foundries were up against.

Mr. Pearce said that Mr. Bunting admitted that the iron was not suitable for the purposes intended, and that needed alteration rather than control. No amount of control was likely to be of help.

Mr. Millington said he realised how difficult it was to define any circumstances to lead to technical control of the small foundry, but there were certain facts. In large concerns it was imperative to employ skilled chemists. The small firm was in competition and must take some line of action. He suggested that as each foundry had its own problems, it must work out its own salvation. Mr. Pearce had indicated that the small firm should consult specialists, and there was the B.C.I.R.A., from whom information could be obtained by members. He had recently been one of the party to visit Czecho-Slovakia, and he saw one of the best research laboratories that could be seen. In that laboratory they not only dealt with research, but had a lecture theatre and model room where castings could be seen in section, showing both troubles and remedies. Every apprentice at the works attended the lectures once a week, and was fully trained to a highly-skilled technical man. It seemed to him that the small foundries in one area or town might get together and employ a full-time specialist, on community lines, to control and solve their problems. Apart from the composition of irons was the knowledge that the cupola was the solution of most of the troubles, and it lay in low temperatures. If the cupola was not capable of producing a given temperature, then troubles would occur due to graphite. If one got adequate temperature and purchased pig-iron to a maximum carbon content, the troubles could be overcome.

Mr. Pearce said he endorsed every word said about the Skoda works, and it seemed a pity they should have to show us the way. He appreciated Mr. Millington's words on the B.C.I.R.A. and endorsed his remarks on the cupola. He summed that up as melting conditions. It was in the furnace that the founder should look for the bulk of the improvement in cast iron.

The Author, agreeing with some remarks made by Mr. Sanders as to fracture buying, said that had led to buying to analysis. Some founders bought to both fracture and analysis, and that created a great deal of trouble. It was possible to buy to fracture or analysis, but practically impossible to buy to both together.

Summing up the discussion, the President (Mr. P. A. Russell) said it seemed a great deal revolved around the cupola, and he thought the Branch should ask Mr. Pearce, or one of his colleagues, to come down to tell them how to control the cupola and get a good iron. With regard to the idea of the co-operative laboratory for the East Midlands area, that did call for thought, in view of the fact that one could get routine analysis reasonably cheap, but it was worth while consideration whether it was advisable in this district. It had to be a very large foundry to run its own laboratory.

A vote of thanks, proposed by Mr. E. Stevenson and seconded by Mr. Lucas, was received with acclamation, and Mr. Pearce responded.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Grain Size of Malleable Cast Iron.

To the Editor of The Foundry Trade Journal.

Sir,—According to your report of Dr. Loepelmann's article on the above, published in The Foundry Trade Journal of November 9, grain growth is stated to take place at temperatures below A_1. He anneals a blackheart iron at 1,050 deg. C. for 20 hrs., lowers the temperature below A_1, raises it again to 950 deg. C. and quenches a sample from above A_1. He reduces the grain size from 2,180μ^2 at 1,050 deg. C. to 125μ^2 by this treatment. He then states that on further annealing below A_1, there is still more grain growth.

Now, it seems to me that by reducing the grain size in his sample to 125μ^2, the material is in a state of strain, and that the further annealing below A_1 will undoubtedly increase the grain size for that reason alone.

For example, in tempering a quenched steel below A_1, and on increasing the time above that necessary for the complete chemical transformation, there is further loss in tensile properties and an increase in elongation due to grain growth.

My point in writing the above is that I should be extremely interested to know if Dr. Loepelmann has proof of increased grain growth, in a *normally* annealed blackheart iron, due to long periods below the A_1 point.—Yours, etc.,

H. G. Hall,
Shotton Bros., Limited.

Manchester Street, Oldbury.
November 12, 1933.

Early Roll Founding.

To the Editor of The Foundry Trade Journal.

Sir,—Further to my letter of the 3rd inst. *re* "Early Roll Founding," I omitted to state that at the time spoken of, *i.e.*, about 1796, there was at Hayle, Cornwall, a rolling mill. The following extracts may be of interest to Mr. Cookson. "The various works for roasting and smelting ores (copper) and rolling metal in this place and vicinity (Hayle Copperhouse) are arrived at as great perfection as in almost any other part of the kingdom. The works were first erected between 40 and 50 years ago." This extract is from page 503 of "Cornwall" in the series "The Beauties of England and Wales," published in 1801.

The rolling mill is described thus in 1824: "After smelting and refining, the ingots are usually sent to the battery and rolling mills, which are about 2 miles distant from the smelting works, where they are rolled into sheets and bolts and hammered into furnace bottoms, etc. The cakes are first heated in a reverberatory furnace, and then introduced between cast-iron rolls, which are brought nearer together after every operation. There are in this mill three pair of sheet rolls, and one of bolt rolls, the largest are 5 ft. long and 18 in. dia. There are also two large hammers (the largest weighing 7 cwts.), which may be made to strike nearly a hundred times a minute, as well as machinery for slitting iron and copper into wire. The rolls are turned and all the machinery wrought by water wheels. The power of this mill is equal to the manufacture of 700 tons a year, but its usual quantity is about 450 tons."

Although the above rolls were very probably made at Hayle foundry, the majority of rolls produced there would be for the crushing machines, as described in my letter of the 3rd.

Trusting the above will be of interest, and assuring you if any further information is required *re* the rolling mill or foundry at Hayle I will endeavour to supply it, Thanking you if you will pass this on to Mr. Cookson.

I remain, yours sincerely,

T. R. Harris.

41, Roskear Road, Camborne.
November 13, 1933.

Book Review.

A Short History of Pewter.—By E. Englefield. Published by Brown & Englefield, 1, Little James Street, Gray's Inn Road, London, W.C.1. Price 4s. post free.

Of metals and alloys of common usage, we confess, that until we read this book pewter was the one we knew least about. We knew that it was an alloy of tin, antimony and lead, but had no idea that this was the baser type, and now we learn the highest quality, "tin and temper," is compounded from Cu, Sn and Sb. It is cast into gun-metal moulds, but no cores are used, and if hollow castings are to be made, then the "slush" process is used, that is, a fair thickness of skin is allowed to solidify, and then the balance is poured back into the crucible. That the articles must be cast and then worked up by turning and hammering, whilst much use is made of soldering. Thus, it will be seen that pewter manufacture is one of the lesser known of the foundry trades. Britannia metal is somewhat similar, but is a spinning from sheet metal.

The book itself is extremely interesting to read, but a proper adherence to the time-honoured method of chapters would have improved it. As it is the authoress has digressed somewhat, but still in a very interesting manner, into all sorts of interesting bits of history. One of these which finds its way into the text is a reproduction of a wood-cut by Jost Amann, of Nuremberg, published in 1568, which carries the caption "Der Kandelgiesser—which we would translate as "The Pot Founder or Caster." We are sincerely indebted to Miss Englefield for introducing us to a phase of foundry practice of which we knew nothing, which is not surprising as her firm is the only one in London to pursue this venerable industry.

Catalogue Received.

Gears.—We very much admire the publicity matter emanating from the house of Messrs. David Brown (Huddersfield), Limited, Lockwood, Huddersfield, and their latest publication No. F 330.1, dealing with helical gears, well maintains the high standard we have learnt to expect. This firm now has its own steel foundry at Manchester and thus keeps control of all the individual items which go to make up a reduction gear. We have sometimes thought that during the recent reign—now happily ending—of the buying fraternity, that good-will was worth practically zero, but we would always make an exception of "Brown's gearing," as it does carry weight with experienced engineers. Actually, this catalogue, in addition to the 21 pages devoted to the subject proper, carries about a dozen specifications and data sheets, the latter including a vast amount of really useful information for engineers.

A fire broke out at the works of Messrs. J. J. Hardy & Sons, Limited, brassfounders, etc., of Throston Bridge, West Hartlepool, last week-end. It was confined to outbuildings, and the main manufacturing portion of the works was not damaged.

Some Practical Considerations in a Small Jobbing Foundry.*

By B. Gale.

In these days of huge combines and mass-production shops, it was somewhat surprising and yet pleasing to read the leader in THE FOUNDRY TRADE JOURNAL of July 20, 1933, entitled "The Future of the Country Jobbing Foundry," in which it was said: "Yet, realising that the country jobbing foundry is an ideal place for youngsters to learn their trade, nobody deplores their present parlous condition more

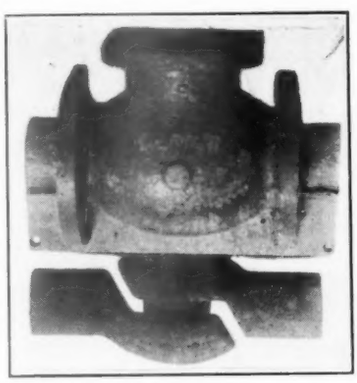


FIG. 1.—STANDARD GLOBE VALVE PATTERN AND CORE.

than we. . . . If the larger establishments would send them their one-off jobs, they would in the long run be helping along their industry by keeping alive these real nurseries for future craftsmen."

The article in question certainly referred to the very smallest of shops, without any means of mechanical aid to assist them in the stern fight for existence, as it referred to hand-mixed sand, boiler-tube cupola and castings made from scrap iron, and it is not proposed to deal with that class of foundry, but, nevertheless, the remarks concerning the craftsman does apply to the small foundry in general. For this Paper an attempt will be made to give an outline of some of the methods by which a small foundry concern manufactures some of the higher-grade castings.

Perhaps a brief description of the foundry will be of assistance in visualising the scene. The foundry is not connected to any engineering concern and is, therefore, dependent upon securing general casting orders, in the open market, for its trade. Imagine a small shop having six moulders, four moulding machines, two core-makers and the usual complement of fettlers, labourers, cupola-tenter, etc., open to take any class of work from one-off jobs up to 4 tons in weight and small repetition castings in any quantity, up to 3 cwts. The moulding machines are all of the hand-ram types, and that section has no power appliances, but metal, sand, castings, etc., are conveyed by monorail runways. The sand-mixing department is served by a disintegrator and a roller mill. Floor sand is prepared by a "Royer" machine, whilst melting is effected by two Whiting-type drop-bottom cupolas, of 30 in. and 18 in. internal diameters respectively. The core-making department has three stoves, coke-fired, of varying sizes, a belt-driven oil-sand mixer, and a hand-driven rotary core-machine for the production of round cores up to 2½ in. dia. The fettling department has the usual fixed emery wheels and rumbler, and electrical portable grinder and wire-brush for the larger castings.

* A Paper read before the Wales and Monmouth Branch of the Institute.

Material Control.

The control of materials affects all foundries, whether large or small, but the small foundry is very greatly handicapped for several reasons: (1) It cannot afford to employ a chemist in a laboratory of its own, and must, therefore, depend upon practical tests for some of the materials. What analysing is done has to be sent to a consulting laboratory, possibly in another town, with consequent delays; (2) it cannot afford to buy in large quantities, and is, therefore, liable to get varying qualities at each small order; and (3) it cannot afford to experiment with "sample trucks" of a material, as a truck-load may be a month's supply, and, therefore, acting on the principle of "leaving well alone," may be paying a higher price than is necessary.

Believing that metal analysis is one of the major points in material control, it is necessary to have every truck of special pig-irons sampled and analysed, in order to be able to control the mixtures for high-grade castings. In the case of pig-irons to be used for the manufacture of high-pressure castings, pig-irons are bought to analysis, and rejected if out of the specified limits. Common irons are not so seriously dealt with, only occasional analyses being taken for checking purposes. Mixtures for pressure castings are periodically analysed for checking purposes, and all castings made in these mixtures are date marked, so that, in the event of porosity troubles arising at some later date, maybe two or three months after casting, the date, mixture details, etc., can be traced to give indication of the expected analysis of the metal. An analysis of the faulty castings should give indication of error in cupola charging or of the allocation of the metal on that particular date.

Coke and Foaming Slags.

Coke is a very complex material, and it has been shown from personal experience that a certain coke that will melt metal admirably in one cupola will have adverse results in another, and in the case of the small foundry this is a material where the author would advocate the policy of "leaving well alone." Cheap coke may be false economy. It is quite realised that a margin of 2s. or 3s. per ton may, in a large firm, effect a saving of some hundreds of pounds sterling per year, but to the small user this saving is not of such importance. To look at it

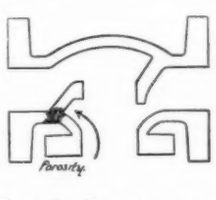


FIG. 2.—SECTION OF A STANDARD GLOBE VALVE.

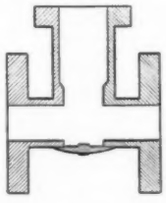


FIG. 4.—SECTION OF A WEDGE VALVE BODY.

another way, if one is melting 10 tons of iron with 1 ton of coke, and the saving in price is 2s. per ton, the price per cwt. of the molten metal is only effected by 0.12 of a penny, and so small an amount cannot be taken as an inducement to reduce casting costs. Is this small saving worth while if the small foundry is to be saddled with a month's supply of coke, which is of inferior quality? The author recently had a peculiar and somewhat costly experience with coke. For about three years the coke supply had given excellent results and trouble-free melting. It was decided to try a sample truck of another coke which had a reputation of being superior to the one in use, and on analysis and physical testing the coke appeared to be a good-quality foundry coke. As soon as the foundry commenced using the coke, troubles began. At two or three hundredweights of metal the furnace became choked up to the tuyeres with a foaming slag, and when the slag hole was opened the operators could not get rid of the boiling mass of slag in the cupola. The slag, when cold, resembled a porous, spongy mass, and a barrowful weighed only ½ cwt. Different blast pressures were tried, but with no improvement, and the management had to throw out the whole supply and get back to the previous source to overcome the trouble, and it was naturally chary on the subject of trying another coke. For a month or two all went well, and then the trouble recommenced. The suppliers

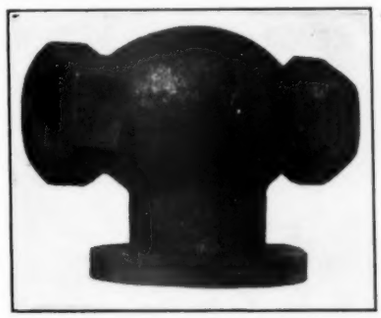


FIG. 3.—GLOBE VALVE WITH HEXAGON ENDS.

of the coke closed down their ovens, and the foundry was compelled to find a new supplier. It tried several brands of coke, but could not find one to give the same clean, hot melting to which it had been accustomed. The management could not explain the trouble, and could not understand why one coke should give excellent results, whilst others, at the same iron-coke ratio, and similar melting conditions, should be contrary, and it went thoroughly into our melting conditions to ascertain whether the trouble was in our own hands, but it could not find a solution, and was compelled to seek other coke supplies. Then the management enlisted the aid of several of their foundry friends, and also put the question before chemists, but it was unable to obtain any definite conclusion. The only "tip" to overcome the trouble of the foaming slag was taken from a Paper read before the Wales and Monmouth Branch by Mr. G. Moran, and published in the Proceedings, Vol. 25, which suggested an increase in the coke-bed charge, but to keep the bed at a high level greatly reduced the iron-coke ratio and was consequently expensive, and experiments with further cokes had to be made until conditions could be got back to good melting on the usual procedure. This trouble is not now experienced with the coke in use, but it would be interesting to learn the views of others as to the cause of the foaming slag trouble. The peculiarity of the whole trouble was that it was associated with the melting of steel-mix cast irons. Any of the cokes appeared to melt straightforward common irons successfully, but as soon as steel scrap was incorporated into the charges, the trouble commenced. It is felt that the coke must be the cause of the trouble, as previously, and now the foundry has used steel scrap daily, and it has a constant supply of this material of identical analysis and quality.

Moulding Sands.

Moulding sands are mixed in various strengths to suit the varying types of work, and but little difficulty in the control of this material is experienced. The foundry is fortunately placed for supplies of excellent-quality red sand in the district, and coal dusts are purchased from manufacturers of repute to the specified grades. For green-sand work, only the heavier castings

have any blacking coating, it being personal experience that for green-sand castings of light and medium weight sufficient protection from sand fusion is effected by the coal dust in the sand. The continual use of sea sand for cores and moulds makes the floor sand rather poor in bond, and this is overcome by making the facing sands rather rich in new sand.

Core Sand and Core Making.

Fully 90 per cent. of the cores are made in sea sand, bonded with proprietary brands of core binders. At various times the author has experimented with rock sands and river sands, but with small measure of success, as these are not generally reliable. Whilst one supply may be satisfactory, the next lot from the same source

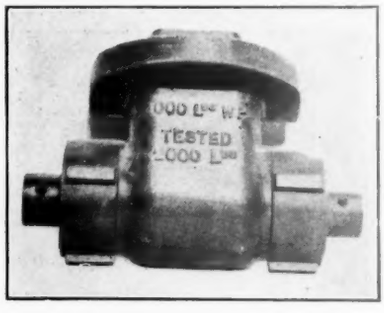


Fig. 5.—Heavy Duty Wedge-Type Valve.

may be entirely different in composition. Seashore sand has not given any trouble and each supply can be relied upon. The binding materials, however, are an entirely different proposition, and there is probably more necessity for testing these materials than any other foundry material.

There are so many types of binder on the market, at all sorts of prices, that one must test out a binder in one's own works. Laboratory tests and figures may be quite good for a binder, but it does not follow that that particular binder is suitable to individual classes of work. It is not intended to depreciate laboratory testing. Far from it, the author is firmly convinced that the chemist is a vital necessity to the foundry industry, but he believes that there are instances where practical conditions have a large bearing on the success or failure of a material, and core binders come in that class.

It is generally possible to obtain a sample of a binder for testing purposes, and personal procedure of testing is to make a comparison of the new binder with the one in use, as follows:—The new binder is measured into the mixing mill at the same proportion, by volume, of binder to sand as that in present use. It is milled for a definite time and placed on the core bench. An exactly similar batch of the present binder is also prepared. Then, a measureful of each binder is weighed and costed at its particular price per cwt. Mixing time being equal, a comparison of these figures will indicate which binder is the cheaper per cwt. of mixed sand. Should it be found necessary to mix one type of binder for a longer period than the other, time of milling must be taken into consideration. The next test is for greenbound strength by the overhanging drop test. The two or three test-bar cores are made in each type of sand and placed in the oven on the same tray. Baking time will undoubtedly vary with different types of binder, and particular notice of baking time is taken to show which is the cheaper in time, fuel consumption, etc. The baked cores are then compared for smoothness of skin. The test-cores are then subjected to a transverse test, and if one has a predetermined breaking strength, these figures will indicate whether more or less binder is needed per mixing. The cores are then tested for water absorption by placing in a jar of water and leaving for a definite time. Comparison can be made of the water absorption of the cores by the softening. The last practical test is to make two identical castings with one core in each type of sand, and these can be examined for signs of blowing, scabbing and for the manner in which the burnt sand leaves the casting during fettling. The whole series of these tests can be carried out with a sample pint of binder, in a very short time, without having to resort to the expense of laboratory testing, and will show what may be expected from a material in one's own foundry, using one's own particular processes. It is doubtful whether any particular core job requires all the qualities determined by these tests, and it is, therefore, up to the foundryman to judge the binder according to the demands of the job for which the binder is required. For instance, he may not require a greenbond, or he may not be particular about water absorption.

Three Core Mixtures Used.

In the author's works, every core that can possibly be made in oil sand is so made, three mixtures of sand being found suitable for any type of core encountered. Where possible, cores are made in halves, on flat plates, in a mixture of sea sand and thin oil binder. This type of core is the cheapest method, giving, when baked, a hard, strong, waterproof core, and can be mixed at 40 parts of sand to 1 of binder, and as one is able to use wet sand, the heavy cost of drying sand is avoided. This sand has little or no green bond. For cores having awkward shape or overhanging pieces that demand the use of a greenbond sand, a treacly compound is used and dry sand is essential. A greater volume of binder must be used, as it appears that the greater the greenbond strength with a given binder at a given proportion, the lower the baked transverse strength. This appears to be accounted for by the effect of the water. A test recently made with a binder mixed at 40 of sand to 1 of binder and dry sand gave a green drop of 1¾ in. with a transverse baked strength of a breakage at 22½ lbs. on a 1-in. square core at 6-in. centres. A similar mixture, but with 2 parts of water added, reduced the green drop to 1 in., but increased the transverse by over 50 per cent. to 37½ lbs. Now, as water alone cannot give the strength, and all water is driven off during baking, the extra strength must be obtained during the mixing, and probably the addition of water in the mixing mill emulsifies the binder and gives a more even distribution on the sand grains than when dry sand is used. Therefore, as water reduced greenbond, and greenbond is necessary, extra binder must be added to the dry sand to give the desired baked

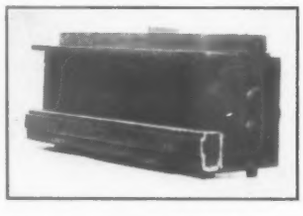


Fig. 7.—Press Tool Casting Used as Pattern.

strength to the core, the mixture being 30 of sand to 1 of binder. The third sand mixture is sea sand and red sand in equal proportion and the oil binder. In this case 1 part of oil is used to 30 parts of sand, as the clay bond acts adversely on the oil binder and extra oil is necessary to give a hard core. In some districts, such as the Midlands, the cost of the extra oil is offset by the vastly cheaper price of red sand to sea sand, but in other places that would not apply. The mixture has the advantage, however, of producing a very strong greenbond without having to resort to dry sand. Whilst this sand is more open than ordinary loam core sand, it is, of course, not so porous as the all sea-sand mixtures, and venting must be employed or blowing and scabbing will probably occur. The main use for this mixture is for the round cores on the rotary machine, the strong green bond allowing long lengths of core to be made without cracking and distortion, and as the machine automatically vents the cores, they are trouble-free. The cores when baked are exceptionally hard and waterproof and can be made and stocked for indefinite periods without deterioration.

Melting.

The success or failure of any foundry depends upon its cupola practice, and in the small shop

Fig. 6.—Clack-Type Retention Valve.

this section demands the most careful control, especially in times of poor trade. There is a 30-in. and 18-in. cupola, the latter being termed "an emergency cupolette." In normal times such is the case, but under the conditions of the past year or two the larger cupola has become the "emergency" one. Clients' demands must be met daily, and if one is to cast only two or three times per week much business is lost. To run the large cupola for small casts would be too costly, and the small cupola is an undoubted asset to the small foundry, it being possible economically to melt for as low as 10 cwts., and quite suitable for casts of 2 or 3 tons. It has, of course, a limited field for the size of the castings to be poured, as the well of the furnace can only hold 5 cwts. of metal, and if a half-ton casting is required to be cast hot, it is essential to use the larger cupola. A 14-cwt. balance-weight, however, has been cast out of the small cupola, but the metal was rather dull. The small cupola has been designated as unsuitable for the production of good-quality molten metal, but the author cannot agree with such statements, personal experience being that, with careful control, the reverse is the position. For instance, he uses a metal for one class of casting where a phosphorus content of 0.4 per cent. is sought. During the past year, chemists have periodically analysed this metal, and reports show the contents ranged from 0.37 to 0.43 per cent. Probably these figures prove that with careful control the small cupola can produce good-quality metal of uniform analysis. All charges of metal, coke and limestone must be carefully weighed, and, with the use of a blast gauge and a time-piece, metal can be controlled to very fine limits. The cupola frequently melts five distinct classes of metal for a 30-cwt. melt, a typical day's cast being as follows: (1) Austenitic iron (nickel-copper-chrome); (2) soft iron for small machine parts, electrical work, gauge cases, etc.; (3) medium Si and low P iron for pressure valves; (4) low Si, low P cylinder iron, and (5) low Si, low C, white iron. A study of this charge sheet reveals: (1) Austenitic irons are very expensive and must be cleared before running into soft irons; (2) high Si, high P iron for light castings must be melted hot. Migration of this metal into the next charge would result in leaky

valves and, conversely, miscalculation resulting into charge (3) being poured into light castings would cause waste due to castings being unmachinable; (3) for medium Si, low P, high Mn, hot metal is vital, whilst migration into charge (4) would cause leaky cylinders. Converse migration is not so serious, as the cylinder iron would make good valves, but would be

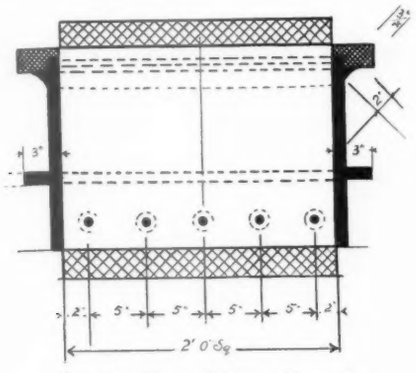


Fig. 8.—Coke Hopper Casting.

rather costly; (4) for low Si, low P cylinder iron, migration to charge (5) would be disastrous, as that is a white iron, and (5) in white iron any miscalculation into charge (4) would scrap any cylinder castings.

It will be seen that difficulties must occur when casting such a varied lot in small quantities, but with care and a definite plan of procedure the difficulties can be dispersed. A good plan to prevent migration of the charges is to use a little extra coke between each class of metal, this temporarily holding up the melting and giving the cupola-tenter indication of the approach of a different class of iron. He must, of course, have a daily charge sheet, and must know the capacity of his ladles, so that as he taps off the metal he will have some knowledge of the position of his next metal. Thus, if he has overcharged one grade and he has no moulds into which to pour the excess, he must pour down such excess into a pig-bed. If, on the other hand, he has under-estimated the amount of a certain class of iron, he must leave the moulds uncast, and arrange another charge of metal at a later stage of the blow.

Moulding Practice.

Many and varied are the types of castings made in the small jobbing foundry and many are

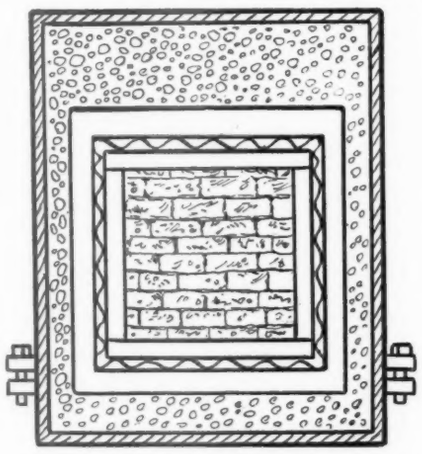


Fig. 9.—Diagrammatic Sketch of Coke Hopper Mould.

the problems to be solved. High- and low-pressure valve castings, for oil, steam and water, are one of the foundry's regular lines, and whilst metal composition can be arranged to give rapid freezing, every type of pattern has its own particular problem. Varying metal thicknesses must be taken into consideration when setting out the job and arranging the running of the castings.

Fig. 1 shows a standard globe valve pattern and core. The main difficulty encountered is segregation between the heavy valve seating and the thin wall. To prevent segregation the metal is mixed to produce a dense grey iron of medium silicon, low phosphorus and medium total carbon. This type of metal will overcome the internal segregation, but if the composition is too low in T.C. one is liable to run into another trouble due to external shrinkage. The placing of the runner to prevent "hot spots" is of utmost importance. The most satisfactory position in this valve being in the back of the inlet flange, this being the farthest point away from the junction of the valve seating and the body. It should be noted that the cover flange on this pattern is set outside the main flanges, as this point is raised in Fig. 2, which shows the section of a similar valve, but it should be noted that the cover flange in this case is set between the main flanges.

The junction of the two flanges and the valve seating makes a natural "hot spot" that must be assisted in cooling, as the arrangement of the runner cannot avoid the trouble. The most simple manner is to insert a large-headed horse-shoe nail in the joint of the core at this point. This forms a densener to eliminate porosity at this point, and the nail stem can be readily chipped out during fettling.

Fig. 3 shows the same type of valve, but with hexagon ends instead of flanges. The ends are

Fig. 10.—Small Steam Cylinder Pattern.

bored and screwed fine thread, and to run in the same manner as the flanged types would be disastrous. The runner in this case must be in the cover flange, at the outlet side so that a hot spot is avoided at the valve-seat junction. Fig. 4 shows a section of wedge-valve body. The important point is the junction between the flange neck and the wedge seating. Running of these types of valves is best effected in the cover flange. Fig. 5 shows a heavy-duty wedge-type valve, tested to 2,000 lbs. per sq. in. pressure, which presents similar features to the previous types, and running should be in the cover flange. All types of valves illustrated are liable to shrinkage in the necks of the flanges. Liberal venting at these points will permit the rapid escape of the hot gases and prevent this source of trouble. Most of the valve-body castings shown are made on hand-ram moulding machines and are very simple in production. The runners are arranged by the management and are fitted on the pattern plates with the pattern. The cores made in oil sand are made in halves, on flat plates, and are placed into the moulds unjointed.

Fig. 6 shows a clack-type retention valve. This is probably the most difficult type of valve casting. Its design is particularly uneven in metal thicknesses and hot spots, and conducive to porosity troubles. Not only are there the thick and thin sections of the flanges and body walls, but heavy bosses in mould and core to carry the clack spindle. Sometimes it is aggravated by further bosses being added to carry a by-pass valve. Efforts were made to equalise cooling by the insertion of denseners in core and mould, but that was not entirely satisfactory, and metal composition appeared to be the only solution to the trouble. It will be realised, however, that for small orders, and this type is

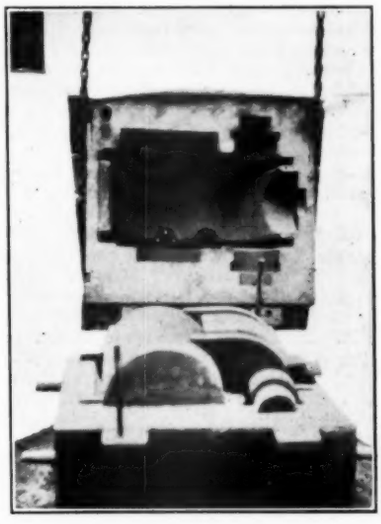


Fig. 11.—Mould from Oil Sand ready for Closing.

generally for only one or two castings, special metal charges could not be arranged, and the solution was found in using the same metal with a ladle addition of 1.0 per cent. nickel and 0.3 per cent. chrome.

For jobbing work large use is made of oil sand in the moulding practice. Oil-sand cores are often utilised to cut out jointing, and for small dry-sand work the author prefers an oilsand mould to ordinary dry-sand practice. Not only is it safer, but cheaper in cost of production.

Fig. 7 shows the use of an oil-sand core to aid moulding. The pattern was sent by the customer and was a replica of the casting. The face had to be perfect for press-tool work and was not to be machined. To make this face perfect in a green-sand mould would be practically impossible. The draw of the pattern would undoubtedly break away some of the sharp edges, and mending would be a long and tedious job for the moulder. To ensure a good face, a core was made from the pattern in oilsand. This was facilitated by being able to draw the pattern in the opposite direction to that employed when moulding. When baked, the core was fitted to

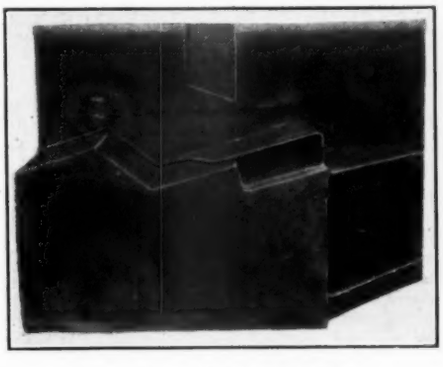


Fig. 12.—Oil-Box Pattern.

the pattern and rammed up in the mould. The resultant castings had a clean sharp face.

Consider making the casting in green sand. The castings weighed 25 cwts. and the metal thickness was about 5 in. The mould would need to be well rammed to prevent swelling. It would require particular care in venting and

mending to keep a true contour and prevent scabbing and blowing. On drawing the pattern, the oil-sand core was sufficiently hard to prevent any breakage, and mending, sprigging, venting and sleaking were entirely eliminated.

Fig. 8 shows the section of a coke hopper casting on which 50 castings were to be made. The first consideration was to make in green sand, vertically, with draw-in facings, but this was cut out on the time required to ram such a bulk of sand, and the cost of the metal pattern that would be necessary. The second idea was to make horizontally with a core for the centre, but here again the core would take up too much sand and time, and would be heavy and bulky to handle. This method is preferred to the former, as the core could be made with oil-sand walls and floor-sand centre to save the cost of the sand. The author then had the idea of making the core in four slabs to facilitate handling. He had the pattern made with core prints, as shown in Fig. 8, by the crossed section. The core slabs were made 1½ in. thick. Fig. 9 shows a diagrammatic section of the mould. The bottom slab was lowered into the print, then the two side slabs. The centre was then filled up with bricks and floor sand at the top slab placed in position. In this manner one moulder made, cored, and cast three moulds per 8½-hr. day, and the core-making time for the three moulds was 3 hr.

Fig. 10 shows a small-size steam cylinder pattern. These cylinders appear to be quite simple dry-sand practice, but a closer examination shows many hot spots, and metal thicknesses in the smaller sizes will vary from ½ to 2 in. The first attempts at this class of work were rather disastrous, the main troubles being porosity and dirty bores. A slight alteration to metal analysis, and the use of the horse-nail denseners successfully eliminated the porosity troubles, but the pin-holes in the bore persisted. This trouble did not entirely scrap the castings, as it was possible, in some cases, to cut away the holes during boring, but this entailed extra machine-shop practice, and had to be perfected.

Various methods of running were employed, and the moulds cast at a very high temperature, reaching to above 1,400 deg. C. Opinions of various experts were sought, but they could not for some time overcome the trouble. They were of the opinion that the trouble was mainly gases that were trapped under the large bore core, and it was decided to experiment with oil-sand moulds instead of the usual dry-sand practice, with a view to more quickly releasing the gases.

Fig. 11 shows a cored oil-sand mould ready for closing. The first mould was not entirely successful, but was a decided improvement, so it was tried again with a little more provision for the escape of the gases by placing large vents through the top mould over each core print, and a perfect cylinder was made, and seven others, of varying sizes, were equally successful.

The trouble had now been conquered as to porosity, machining, etc., but the management was not satisfied with the general appearance of the castings, the oil sand giving a rather rough skin, and causing "ratching" in the corners. Various coatings of plumbagoes and blackings were tried, but the nice clean skin that is associated with the dry-sand moulds could not be obtained. It should be noted that in the dry-sand moulds the wet blacking was applied before stoving, and blacking could soak into the mould and penetrate to a good depth without having any ill-effect on the moulds, but with oil sand this could not be done. The moulds were made in a bonded oil sand, and therefore the addition of a wet blacking would cause the collapse of the mould, as the sand would lose its bond. They were therefore blacked after baking, whilst hot, and the sand being water-proof, the mould was only coated with the blacking. The management was compelled to look elsewhere for a solution of the trouble, and it tried an addition of red sand to the sea sand, and whilst this effected the desired improvement to general appearance, it fell back to the previous trouble, as the red sand reduced the permeability of the mould. The only alternative appeared to be to cast at a lower temperature. Now, all this time, the foundry had been working on the assumption that a cylinder casting could not be poured too hot, and the aim had been to pour at a very high temperature. It was decided to try melting at the same high temperature, but pouring when the temperature had dropped to about 1,350 deg. C., and this measure produced a good casting in all respects. This practice has been successfully continued, and not only has it eliminated sources of waster castings, but the production costs of the oil-sand moulds are lower than the dry-sand moulds. Moulding is considerably easier, the mould can be looked upon as an ordinary sea-sand core dried in a box, and sprigs and irons can be largely dispensed with on account of the plasticity of the sand in the green state and the hardness of the mould in the baked state. Venting can be treated far less seriously than in a loam mould, on account of the greater permeability of the mould. No lifters or gaggers are required in the top mould, but to allow the top part to be clearly lifted, the pattern must be lifted with the top box, being secured by screws and fishplates. When assembling, the cores can be gently rubbed into the prints, ensuring a perfect fit without either crushes or flashes, a point that is of utmost importance, as all cores must be supported by the prints without chaplets.

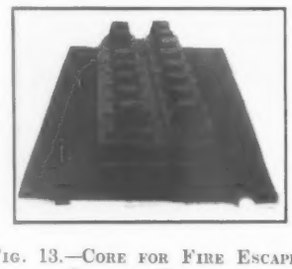


Fig. 13.—Core for Fire Escape Landing Plate.

Fig. 12 shows an oil-box pattern. This is a particularly difficult design, as the metal thickness of the box is $\frac{5}{16}$ in., and the heavy section shown 2½ in. by 2 in. This section is machined, drilled, tapped, etc., to form oil valves and the slightest porosity causes a scrap casting. To use an iron similar to the cylinder metal or the valve metal is out of the question, as the thin section of the box would be too hard for machining, so the cooling must be assisted by the use of heavy cast-iron denseners in the core for the full length of the heavy section. This is cast in the bottom of the mould, the cores being suspended to the top box. Another difficulty to be encountered is cracking, due to contraction between the heavy section in the bottom and the light flange in the top, and to facilitate the rapid collapse of the mould at this point, the middle part of the mould is made in oil sand and the top and bottom in loam.

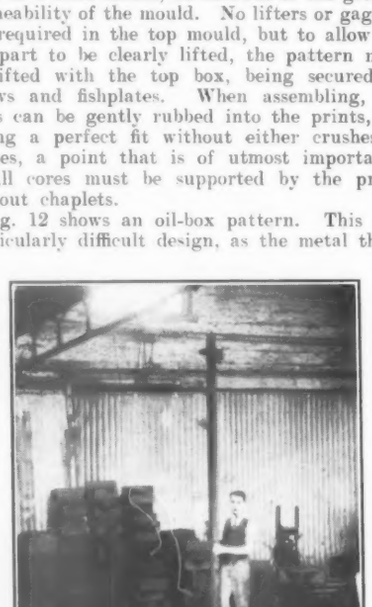


Fig. 14.—Hydraulic Ram 12 ft. long.

Fig. 13 shows a core for a fire-escape landing plate. One often encounters landing plates of varying shapes and sizes, and pattern costs would be far too heavy for a one-off job. At one time a standard-size plate 3 ft. square was used, and all castings had to be made from that pattern by stopping off or moving the pattern along, as the case may be. Now a mould is made of the plate size by strips and strickle and a flat top part, and the void is filled up with sections of the core shown. This is a very simple method, the cores being produced very quickly by boy labour, and the same principle can be employed on many types of gratings, etc.

Fig. 14 shows a pattern of a hydraulic ram, 12 ft. long, that had to be made. This is another instance of the varied type of work encountered in the small foundry, and incidentally is one of the very few types of castings made where the loam core is used. The core in this instance was 12 ft. 6 in. long by 1½-in. dia., and was spun in loam on a ¾-in. barrel.

In conclusion, the author would like to record his grateful thanks to his principal, Mr. Edward Stevenson, for his permission to use his works and practice for this Paper.

A Notable Gathering.

Ex-students of the Metallurgical Department of Sheffield University living in all quarters of the world probably felt their ears burning on November 2, when about a hundred of their Fellows gathered at the King's Head Hotel, Sheffield, to do honour to Dr. F. Ibbotson on the occasion of his retirement from the staff of the Department. It was an open secret that those who were fortunate enough to be present were the guests of Mr. Harry Brearley. Mr. P. B. Henshaw proposed Dr. Ibbotson's health, and no one could have done it better, as eloquence and sincerity were admirably blended.

Mr. Brearley made the actual presentation, which was a silver plaque, mounted on oak, carrying embellishments characteristic of the life's work of Dr. Ibbotson, and a cheque representing money subscribed for by ex-students. Dr. Ibbotson's reply had, unfortunately, to be very short, as he was present against medical advice. Dr. T. Swinden proposed Mr. Brearley's health and Mr. J. H. S. Dickenson that of Mr. F. M. Parkin, who had arranged the musical programme. Amongst those present who are prominent in the foundry world were Dr. W. H. Hatfield, Mr. V. C. Faulkner, Mr. Archibald Allison and Mr. J. R. Hyde.

Heat-Treatment of Cast Iron.—The following is an abstract of a Paper on "The Heat-Treatment of Cast Iron" read by Mr. Carl H. Morken before a meeting of the American Society for Steel Treating held at Detroit recently:—"Originally a more extended use of cast iron was only brought about because of the low price and ease with which it conformed to pattern when cast. It is only in recent years that intense study from a metallurgical standpoint of this metal has been considered worth while, and the improvements resulting from these researches have fabricated a material worthy of the engineer's real consideration. This manuscript presents briefly those heat-treatments which result in particular high-strength cast irons of unusual ductility, shock resistance and fatigue strength, as well as some of the applications which these improved processes are bringing about."

Foundry Handling and Conveying.*

By R. Spriggs.

The human side of mechanisation includes:—(1) The attitude of the men to mechanising; (2) the effect of mechanising on the men; (3) results from the men's standpoint, and (4) the attitude of the foundry officials. One should get away from the idea that the mechanisation of foundries is hard on the men or is detrimental to the men's interests. General experience goes to prove that the man's lot is definitely improved, his work is less fatiguing, and the greater prosperity of the foundry due to mechanisation results in many indirect advantages. As to the effect on the men, here again it has been found that the men who were inclined to object to conveyors are the first to praise them after the plant has been put into operation; never have they had such good sand, and so on.

There is also the question of the way in which a mechanisation scheme is put to the men. Sometimes all the men know is that certain plant is being put in and they have time to imagine so many evil results to themselves that by the time they are put on to work the plant they are just as awkward as they can be. Is it not better to explain the position to the men beforehand and show them where they will benefit? If a founder is putting in a scheme to halve or greatly reduce his costs, is it not reasonable for the men to expect and for the employer to see that the men can get some benefit? There is at least one case where this was done, and the results fully justified the experiment.

Attitude of Foundry Officials.

These executives should not concentrate on the hundred or more reasons why they cannot mechanise their foundries, but should immediately start to devise ways and means to enable them to mechanise. The rewards of mechanisation are real and substantial. It is common knowledge that the managing director of a very large foundry stated at an Institute meeting that the mechanisation of his foundry had reduced costs 40 per cent. Another smaller foundry started up a £4,000 mechanisation scheme some nine months ago, and the results up to the present tell them that the scheme will have paid for itself when it has been running 18 months.

In another case the savings after the point where the completed mould was placed on the conveyor were as high as 50 per cent. The output from moulding machines was also greater, but the author's informant could not give him reliable figures owing to the variety of his work.

Where do these savings arise? The sand is on tap and works through the system automatically; there is no need for a night-shift to knock out, collect castings, prepare the sand and clean up; there are a smaller number of boxes in use; the moulding machines are working to their full capacity all day long, less new sand is used and a better sand of controlled regular bond is obtained.

The mechanisation of a very great number of foundries is bound to come, and to come quickly. It may be pointed out that this or that foundry has experimented without much success, but these experiments are in the past. The teeth-cutting period is over, and successful mechanisation is in full stride and increasing every day.

The mechanising of a foundry is very different from adopting such a system as, say, the Bedeaux system. With such systems the people concerned endeavour by careful time and motion studies to get better results out of the plant generally as it exists, whereas the mechanising of a foundry—and in this is included not only the moulding shop, but the core department and cleaning shop as well—will bring something quite different from what has been in existence before. Mechanisation substitutes constantly moving and mobile materials for the stationary dumps. The sand is on tap; the moulder merely draws what he wants. It is always there and always working round. Founders have to change their ideas from the stationary conception to the notion of the constantly-moving product. In some places it is carried to such an extent that neither a shovel nor a barrow is allowed about the place, even when these old-tried tools would be economical. The reason for this is that anybody knows how to use a shovel and a barrow, but the use of a conveyor system requires tuition. The uninitiated says: "Why should I take my castings for a ride merely to cool them?" The answer is, because they cool quicker that way and they are going where they are required for the next job and in the quantities in which they can be dealt with without dumping.

Executives have to work hard to get their people conveyor-minded. A director of one large company decided to mechanise his casting-cleaning department and stores. His ideal was the continuously-moving stream of castings from foundry to stores and from stores through all processes until finished. He adopted the container and gravity-roller-track system, and laid down the law that the castings were to be put in the containers in the foundry, and were to be conveyed in containers to the sand blast or rumblers, thence through inspection and weighing to the bench grinders, to the distribution warehouse, stores, and to the machine shops. He had to stand over the men to make them do it at first. They thought he was mad, but they do not now. They are all for it now. That man started right; he had an ideal and the determination to put it through. A man must be an idealist for this work, but no dreamer; ideals and energy are the required combination.

The problem of mechanising any foundry is always full of difficulties. There is the necessity for a continuous supply of hot metal; the different kinds of metal for various work; the variety in the moulding; the smallness in the number of castings to an individual order; coring-up difficulties; the difficulty in getting an even flow of work; the necessity for facing sand, etc. However, difficulties are made to be overcome, and it is surprising what difficulties can be overcome by enterprise and enthusiasm on the part of the foundry officials concerned. A good mechanised plant is usually the result of keen study and collaboration between an expert contractor on the one hand and a keen foundryman on the other. The foundryman who stands aside and says to the contractor, "Here is the work; you tell us how to do it," rarely gets a good plant, and does not deserve one, and even if he gets a good plant, his lack of enthusiasm will rob him of many of the profits and benefits that he should get from the plant.

One of the illustrations to be shown later depicts successful mechanisation of a general foundry. This firm make builders' and municipal castings, manhole covers, drain tops, frames, anything, and most of their customers want their own names cast on. The founder could get more work at a price than he could turn out under old methods. He had to reduce his cost and increase his output. He had no room to extend his foundry, and he decided to put in a continuous plant for six machines doing his small work. He put in a mould conveyor and a complete sand plant. He gets an output of 1,100 boxes and 18 tons of castings off that mould conveyor every day. The sand plant was supposed to do 20 tons per hour. He now claims to get over 30 tons per hour out of it, because he has made it serve the rest of his foundry in addition to the machines working with the mould conveyor. Mr. Coggon would say the reason he can do that is because the sand is dealt with by Simpson mixers. It is quite true the plant includes two No. 2 Simpson mixers, and to get the output the founder only gives the sand about 1½ minutes' mix each time round. The reason for this is demonstrated by a film showing the action. This plant has more than paid for itself in the three years it has been in operation; the output is quadrupled.

Handling the Metal.

When one reaches the more detailed methods of mechanisation, there are many contentious matters. The cupola-charging crane, which lifts the charge off the floor and dumps it by a suitable bottom-opening skip, is the best job. It saves the costly platform and lift, and is economical in both first cost and labour cost. There is a growing feeling that the continuous elevator is tending to replace the crane, but, after all, charging is an intermittent job, and a suitable crane will always show up well for the work. For molten metal and for small and medium ladles the overhead runway is still first favourite, especially in continuous plants.

Mould Conveying.

There are two more or less standard forms of conveyor, one being the gravity roller conveyor and the other the continuous slow-moving elliptical track. The gravity roller conveyor is a kind of half-way house. It enables the founder to continue with batch work. The moulder puts his mould on to rollers adjacent to his machine. The moulds are cored up and closed on the rollers, passed forward to the pouring point, thence to the knock-out, and the boxes sent back on return lines to the moulders. This form of conveyor is 50 per cent. more costly in auxiliary labour than the continuous conveyor. At the same time, when combined with a good continuous sand plant, it does enable the founder to get the maximum output out of his moulding machines, which is one of the best reasons for putting in conveyors—what is the good of putting in the best moulding machines if they cannot be worked to the full capacity? The roller tracks do not necessitate a continuous hot metal supply, as the moulds can be poured in batches.

The continuous power-driven mould-conveyor is, as previously stated, usually elliptical in form, although it can be L-shaped or rectangular. With this conveyor, the moulds are placed on the conveyor plates adjacent to the moulding machines; they are cored, closed and weighted on the conveyor; they then pass to the pouring point, then along a cooling section to the knock-out. The knock-out is frequently aptly named, but shake-out is a better term. Many a good plant is spoilt at this point. Flaskless moulds are automatically discharged from the mould conveyor and one man picks out the castings and bottom plates, the sand passing through the grid for re-treatment. One plant dealing with box moulds has a very efficient crane arrangement with vibrating sling.

The knock-out station requires very careful thought and should be designed to suit the boxes. For big boxes containing a quantity of sand a jolting grid is a good feature, but not for small work. In the first place a good jolting grid is costly and small work does not warrant the outlay. For many jobs, particularly in small work, a plain grid is sufficient. The points to consider in these cases are not so much the type of knock-out grid as the labour involved in knocking out. Here is scope for motion and time study, stooping, lifting, etc. Much progress has been made of late years in improving mould conveyors, and the skidder plate type is obsolete.

The first cost of the power driven mould conveyor is heavier than roller conveyors, but there is much less cost in operating, as will be obvious from the films which Mr. Coggon will show later. A mould conveyor of the continuous type should be variable in speed. A P.I.V. speed varier is

* Paper read before the East Midlands Branch of the Institute of British Foundrymen, Mr. P. A. Russell, B.Sc., presiding.

probably the best means of providing this feature, because it is totally enclosed. Enclosed gears, anti-friction enclosed bearings and a shear pin device are other necessities in view of the nature of the service.

Sand Treatment and Sand Handling.

The sand treatment, of course, must be decided by the results you want. Assuming one is aiming at a unit sand (using no facing sand) and desires a good clean finish to the work, tramp metal must be extracted and provision made for adding a proportion of new sand and coal dust, screening, milling and aerating before passing it back to the moulders. Two other important considerations arise—cooling and dust extraction. The necessity for cooling or otherwise depends on the type of work and the heat of the sand when knocked out. The same thing decides the form of conveyor under the knockout. The simplest and cheapest conveyor is a belt, but if the sand is very hot a steel-apron conveyor will be needed. The same applies to dust extraction, for certain classes of work one can afford to ignore the matter, but if the sand gets badly burnt, the dust or silt should be exhausted.

How to Cool.

The operations of screening, milling and aerating previously mentioned communicate much cooling, indeed, sufficient for many jobs, but if extra cooling is necessary, the best plan is to tackle the sand at its hottest place and pass it over an additional aerator pulley or pass it through a cold-air tunnel, ploughing it as it goes to allow the heat to escape, for it will not cool in a bin or hopper.

As to metal separation, there are two types of magnetic separators, one the pulley type and the other the overband type. The latter is more efficient, but costs more. In screening, the author prefers the rotary type of screen, because it throws the sand about more, especially if the angle throwers inside the barrel are spiralled to distribute the sand along the drum.

The question of sand mills is a long subject and will be better brought out in the discussion. It is hoped this matter will be raised, because it is very important, so much so that in a recent advertisement the mill was claimed to be the heart of a good sand plant, and for that reason it was vital to have the best. The final aeration of the sand should take place where it is delivered on to the final distribution conveyor, so that there is no chance of further agglomeration before it gets to the moulders.

Form of Distribution Conveyor.

This depends upon how many feeds are required. If there be 8 or 9 off one conveyor associated with a belt and ploughs, a man will be required to look after the ploughs, but if there be installed a pushplate conveyor, the feeds can be automatic and require no man to attend to them.

There are many special features that go towards making up a good sand plant, such as the best type of elevator, elevators and conveyors versus gravity bucket conveyors, the best type of storage hopper, table feeders, aerators, the necessity or otherwise of maturing hoppers, proportions of new sand required, but if one attempted to deal with all these in detail we should have no time for either film display or discussion. It can, however, be postulated that almost anybody can design and make a sand plant of sorts (mostly bad), but a good sand plant is a job for the experienced expert.

The Fettling Shop.

This is sometimes more important from the conveyor standpoint than the moulding shop. The author has been surprised what savings it has been possible to make by careful organisation and a development of the gravity conveyor in the cleaning shop. These remarks refer primarily to small-casting work and it is impossible to draw up hard and fast rules for the job. Every job must be dealt with on its merits, but the idea of moving castings on boards or in containers through the cleaning and finishing processes is making much progress. Many firms have tackled this end first as being the section most likely to give quick and definite results. The advantages are that the material is always easily movable, it is mobile, and, moreover, is sorted. One can take out the material required for special attention without having a quantity of searching to do, whilst no heap of material is forgotten and not used up. It is all on the line, as it were, and has to be dealt with. It is not lifted and put down a number of times.

The Core Shop.

This, again, depends on the amount of cores to be dealt with. Mr. Coggon would probably have something he wanted to say on this question, but the author would like to show a type of conveyor which is adaptable for core work and also for casting conveying to and through the cleaning departments. This is the overhead chain or pendulum conveyor. It is comparatively new in this country, but has already proved very successful. It is very economical in power; a conveyor about 2,000 ft. long only requires about a 3-h.p. motor to drive it. It is silent in work, reliable and cheap in upkeep. In conclusion, he asked Mr. Coggon to take over and show his films.

DISCUSSION.

Mr. Coggon said he would first take that opportunity of congratulating the new President. The Branch was fortunate in having such an excellent immediate Past-President, Mr. Bigg, followed by an equally good President in Mr. Russell. Mr. Spriggs had spoken of the difficulties in getting works to go in for mechanisation. In times of depression one could expect that. He had spoken of the doubt entertained by the workmen of mechanisation, but it could be justified in many instances. One case instanced related to the pre-war period. A Sheffield steelworks installed mechanisation and reduced costs by one-third, at the same time maintaining the wages level. The manufacturer's point of view was that he could not expect production unless the men had time for rest and recreation. Mechanisation from the ironfounding point of view was essential to progress. Mr. Spriggs said there were two types of conveyors. He, Mr. Coggon, thought there were three, the third being the radial turn-table type, and he would like more information on that type.

Mr. Spriggs replied that if Mr. Coggon meant the ordinary turn-table, that type was now out of date, and was being replaced by the continuous conveyors.

Mr. Coggon said he had in mind a plant where the reverse was the position, the turn-table being installed to replace the continuous conveyor.

Mr. Spriggs said he could not understand that, and he had no data to supply the answer.

Conveyor Speeds.

Mr. Stone (President, Lincoln Section), referring to the continuous conveyors, asked what was the position when moulds had to travel the circle two or three times to get sufficient cooling before passing to the shake-out.

Mr. Spriggs said that was wrong, the moulds should not have to travel two or three times. In designing the lay-out, the conveyor should be set to give sufficient cooling at the one cycle.

Mr. Stone said he had known a case where cylinder blocks, being knocked out at the first cycle, had cracked, but on allowing a second cycle to effect cooling there was no cracking.

Mr. Spriggs said the plant was badly organised. There must be no necessity for passing the cycle twice. In mechanising a foundry one must carefully study all aspects of the job to be done. If moulds had to be left to cool, the whole scheme was a failure.

Knocking Out Dry Sand Moulds.

Mr. Measures said the author had shown the conveyors and shake-outs of large and small moulds in green sand, but he would like information on the shake-out of small dry-sand moulds.

Mr. Spriggs said that could be done on a jolting grid.

Mr. Measures asked if that was the only practical way?

Mr. Spriggs would not say that, as there was also available the vibrating slings.

Mr. Measures pointed out that for small boxes, say 12 in. square, the fitting of vibrating slings would occupy too much time.

Mr. Spriggs replied that for such small boxes the jolting grid would be the more suitable.

Mr. P. H. Wilson, referring to the conveyors for feeding the moulders' hoppers, said that Mr. Spriggs had mentioned the "push-plate" type, whereas the film of the Holwell works had shown the flat belt with ploughs for the distribution of sand to the hoppers. One station might require more sand than another, and this could be arranged by the setting of the ploughs, and thereby getting absolutely correct distribution of the sand, and, from the maintenance point of view, he thought the flat belt to be the best type of conveyor. He thought there was a lot to be said for the "batch" as against the continuous method, but the "batch" had the advantage of being able to turn into continuous if desired. Both Mr. Spriggs and Mr. Coggon had looked at the subject of mechanisation from the plant manufacturer's point of view, and he supposed that the reason some foundrymen fought shy of mechanisation was the fault of some manufacturers. Once an inquiry was placed, some elaborate scheme was evolved and the figure was too high. He thought there were many foundries who should mechanise and there were some very simple plants. Mr. Spriggs had shown that they could be started in a very simple manner and increased. Another point was the quality of the plant, and he would advise that one insisted upon a good substantial job.

Mr. Spriggs said he would still join issue with Mr. Wilson on the question of the sand conveyor. The film had shown that the sand was separated on the belt conveyor, but only to three points, and then when the hoppers were full the sand would continue to be ploughed off the belt and would spill unless there was a man to control the working of the ploughs. With the push-plate type, any surplus went into the next hopper, and so on. He could not see how the belt and plough conveyor could be worked if there were eight stations to receive the sand. In the case of three stations he would agree with Mr. Wilson that the belt was a good job, but not with eight stations. He certainly agreed with Mr. Wilson on the question of "batch" and continuous mould conveyors.

Mr. Bunting said the author had mentioned a plant where the sand was returned to the moulders every hour. Towards the end of the day was the sand sufficiently cooled?

Mr. Spriggs, in reply, said in the case he had in mind there had been no complaints as to hot sand. That was a serious question and had to be kept in mind.

Mr. Stevenson, referring to continuous plants, asked what happened if one man dropped out for a time. Did the plant stop?

Mr. Spriggs replied that the question must be faced. One must have auxiliary labour to take the place of the man so dropping out.

Mr. Stone asked what happened if there was a stoppage due to an alteration of the patterns, or the like.

Mr. Spriggs said that was a matter of organisation. It would stop the plant and give a definite loss. One has to use much more foresight with a continuous plant than with the original floor moulding.

Mr. Walters asked if the author could give any idea of the lower limit of the size of such plants.

Mr. Spriggs said he had shown one plant doing 18 tons in 1,100 moulds per day, but at the

(*Concluded on page* 284.)

The M.B.V. Surface Treatment for Aluminium and its Alloys.*

By Dr. Gustav Eckert.

It is well known that aluminium possesses a high chemical resistance, which has resulted in its use in the construction of apparatus for all kinds of chemical industries. For the same reason aluminium has found an application in the manufacture of domestic ware, in roofing, and in many other instances where it is subject to atmospheric or humid conditions. For many years engineers have been endeavouring to improve the corrosion resistance of the metal to an even greater extent, either by means of a protective coating or by alloying it with other metals known to possess greater corrosion resistance than pure aluminium. In particular, the low corrosion resistance of aluminium in contact with salt solutions has retarded the development of light alloys.

In "Zeitschrift für Metallographie," 1916, page 170, Bauer and Vogel describe a coating process based upon the treatment of the part concerned for two to four hours in a hot solution of potassium carbonate, sodium bi-carbonate and potassium bi-carbonate. An improvement in this process is covered by German Patent 423,758, taken out by the same authors in 1923, and consists in adding a catalyser consisting of an aluminium compound, thus decreasing the time of treatment. These processes have not so far been developed in practice.

During the summer of 1930 the author studied the Bauer-Vogel process, and was able to modify it to such an extent that sheets, castings, etc., could be given a protective coating in three to five minutes, which made them fully inert to action by salt water and other chemical agents. By means of a further impregnation the protective action of the coating was reinforced. Finally, as the use of a hot solution is not always possible in practice, a paste may be prepared of the same composition as the bath, and by this method a coating may be obtained at ordinary temperatures, which is as efficient as the hot bath coating. The process was patented in such a way that its practical applications would not be limited. A large number of companies operating in varied fields in both Germany and abroad now use this process for coating their products, and it is known generally under the name "M.B.V. Process."

The M.B.V. Process.

The bath is composed of an aqueous solution of anhydrous sodium carbonate and anhydrous sodium chromate at a temperature of 90 to 100 deg. C. The proportions of salts may be, for example, 5 per cent. sodium carbonate and 1.5 per cent. sodium chromate. The aluminium parts to be protected are placed in a solution which is maintained at boiling point for a period of from three to five minutes, and are then washed in hot or cold water and dried. The standard solution has a long life; tests have shown that 38 sq. yds. of surface can be protected with 2.2 galls. of solution. On this basis the cost of production of 1.2 sq. yds. of surface can be taken to be about 3½d., and at the same time labour costs are low because comparatively unskilled labour can be used for the treatment.

It is clear that the same solution may be used for some time without the addition of fresh salts, but at the same time the concentration of stock solution does decrease after considerable use, with the result that a longer period of treatment is required. This variation takes place within such narrow limits that it has no practical importance, and even in the extreme instance of a fully-exhausted solution only 25 min. were needed for complete oxidation.† It is thus possible to use a solution with a concentration of only 2.5 per cent. of the standard solution when it is considered that the standard solution is too expensive; for example, in cases where the solution is only to be used for one coating.

Treatment tanks should be of wood, welded sheet iron or enamelled material, but zinc, galvanised or tinned iron cannot be employed. Copper tanks can be used if necessary, but corrosion would be caused after evaporation of part of the water by the deposition of a soda-containing film; there is no restriction on the type of heating used to maintain the plant at the correct temperature. No preliminary treatment of the articles to be protected is necessary, as if the surface is oily or greasy the soda contained in the bath will remove this grease. If, however, the parts are very dirty it is preferable to clean them before oxidation to avoid too quick a removal of soda from the bath.

Low Temperature Application.

Where it is not possible to operate the plant at a temperature of 90 to 100 deg. C. an efficient protective coating can be obtained by operating at 30 to 40 deg. C. for half an hour, at the same time adding 150 to 160 grms. of caustic soda per kg. (2½ ozs. per lb.) of M.B.V. salts required for standard-strength solution. In many instances a paste may be used to advantage, this paste, for example, being made up as follows:—

Sodium chromate	10 parts
Anhydrous sodium carbonate	4 ,,
Caustic soda	4 ,,
Water	10-15 ,,

This paste is applied by brush, and after 10 to 15 minutes of application the part concerned may be rinsed in water. This treatment is of service in many instances, for example, for the coating of portions of apparatus which are susceptible to corrosion or inaccessible parts such as roofing, guttering, etc., or for the treatment of welds. For example, if it were not desired to use the large quantity of solution necessary for the oxidising of a large tank, the component sheets could be oxidised separately in a small treatment-tank, and after welding the welds could be treated with paste in order to give the same definite protection.

Physical and Mechanical Properties of the M.B.V. Film.

The colour of the M.B.V. film varies from light to dark grey, and in the case of cast material decorative effects can be obtained because of the visibility of the metal grain. The coating has a high protective action, and this is dealt with specifically below. Mechanical resistance of the film is not exceptionally high, but nevertheless it will resist the action of ordinary bristle brushes. A secondary treatment, which consists in maintaining the part concerned for 15 min. in a 3 to 5 per cent. solution of sodium silicate at 90 deg. C. followed by rinsing in water, increases the hardness of the coating appreciably and also improves its resistance to corrosive action.

The M.B.V. film is very adherent and cannot be detached by folding, rolling or by pressure, as it possesses a high elasticity. Tests have shown that an M.B.V. protected sheet can be bent at sharp angles and also submitted to rolling without decreasing the protective action of the film. It is noteworthy that even in cases where a part of the metal is left uncovered the metal at this point is still resistant to corrosion. Sheets on which the film had been broken were tested in salt water for some months and after this time it was found that there was no alumina in the solution and the weight of the sheets remained the same as before commencing the test.

Chemical Resistance of the M.B.V. Film.

The M.B.V. film gives a high resistance to corrosion to pure aluminium and to copper-free aluminium alloys. In view of the many advantages of aluminium or aluminium alloy for storage, transportation and manufacture, it is believed that the metal will find many new fields of application when the process becomes better known and has been thoroughly tested by industry. It should be noted that tests have already been made on the M.B.V. film in France, Germany and Switzerland, and very good results have been obtained.

Regarding the secondary treatment to give improved corrosion resistance, this process is not yet perfected, but the author has recently succeeded in notably increasing the chemical and mechanical resistance of an M.B.V. oxide film by annealing after impregnation with sodium silicate. The initial coating was attacked by very dilute hydro-sulphurous acid, but there was no attack after annealing of the sample, and any attack which might occur in the use of light alloys are thus eliminated by heat-treating the M.B.V.-coated part. This question is still being studied, but observations to date show that the improvement results from the annealing of the sheet.

Applications of the M.B.V. Film.

I.—Water and Brine Solutions.

Pure aluminium and copper-free aluminium alloys, after protection by the M.B.V. process, are not corroded by either cold or hot water, even after periods of some years, and tests have shown that the most strongly corrosive waters have no effect on the protected metal. Similarly, hot and cold salt-water solutions of all concentrations have no effect on M.B.V.-coated material.

As a result there is the possibility of application of the M.B.V. process in the following uses of aluminium:—

(*a*) *Tubs, Tanks and Domestic Utensil Ware.*

(*b*) *Hot-Water Circulators.* — M.B.V.-treated aluminium, Pantal or similar aluminium alloy, can be used satisfactorily for the construction of water-heating or steam-distribution apparatus.

(*c*) *Boilers, Hot-Water Containers and Heating Coils.*—The M.B.V. film has already been proved satisfactory for work of this nature. In one instance a set of heating coils was corroded by condensation of hydrosulphurous acid, but this difficulty will be overcome in the future by annealing the treated parts.

(*d*) *Apparatus in Contact with Water.* — For example, distilled-water apparatus, fire-fighting appliances, drinking-water troughs, water pumps, etc.

(*e*) *Heating and Refrigeration.*—For chemical work impure water or sea water is often used in thermal apparatus. The adoption of an M.B.V. coated aluminium alloy prevents all possibility of corrosion.

(*f*) *Thermal Installations.*—In many cases this water has a corrosive action on most metals, so that these installations are constructed largely of wood, which is not satisfactory from a sanitary standpoint. The use of M.B.V. coated aluminium offers new possibilities in such installations.

(*g*) *Guttering.*—In instances where gutters and similar building material cannot be treated by the M.B.V. process before installation, the film may be produced by means of the paste and all danger of corrosion prevented.

(*h*) *Miscellaneous.*—(1) In naval work it has not been possible to produce many articles in light alloy, or where they have been produced, frequent replacement has been necessary because of the corrosion produced by sea water, despite protective painting. M.B.V. coated parts for instruments have been found to be very satisfactory; (2) flexible piping has been successfully produced in M.B.V. protected aluminium; and (3) the salt-spray testing cabinet at the Erftwerk Laboratory is constructed entirely of

* Extracted from a British Aluminium Company's Publication.
† The term "oxidation" has been adopted, but in reality the action involved is much more complex.

aluminium and Alpax treated by the M.B.V. process, and is operating satisfactorily.

II.—Alcohols and Hydrocarbons.

(*a*) *Methyl and Ethyl Alcohols*, as well as their aqueous solutions of all concentrations, have no effect at any temperature on M.B.V.-treated metal. This is also true of hydrocarbons, so that M.B.V.-treated aluminium may be used satisfactorily for feed-pipes and tanks in the fuel-oil and petrol industry.

From the standpoint of corrosion resistance, aluminium is satisfactory in fractional-distillation apparatus, and this opens up new possibilities for the use of the metal in certain sections of the chemical and pharmaceutical industries.

(*b*) *Alcoholic Beverages and Liquors.* — Tests have shown that the M.B.V. film is inert to alcoholic liquors, and as a result there is considerable application for aluminium in the transport of such liquids. Tests which have been completed up to the present time have given excellent results.

(*c*) *Beer*, even of an acid base, has no effect, and transport vessels, both for domestic use and overseas, may be made of aluminium. It should also be noted that even if dregs are left in the casks these will have no effect on protected metal. Tests on light-alloy beer siphons have given satisfactory results, and in this case a coating of M.B.V. film is essential because of the colouring effect of the water remaining in the siphon base. Such siphons are being used to-day in cafés, hotels, etc., because of the advantages which they offer over glassware.

(*d*) *The Perfume Industry* may offer an important new outlet for light alloys because the M.B.V. film removes all chemical difficulties. Aluminium can be used in apparatus for manufacturing, testing and transportation of perfume.

III.—Chemical and Similar Industries.

The following is a summary of the materials which have been in continuous contact with M.B.V.-coated aluminium for a number of months, and which have had absolutely no corrosive action on the metal: Photographic developer, fire-extinguisher foam, urine, soft soap, copper-oxide paste, copper sulphate, sodium bisulphite (2 to 10 per cent. solutions), saturated calcium-sulphate solution, calcium-chloride solutions at 10 per cent. and 60 per cent. concentrations at 20 deg. C. and 10 per cent. solution at 60 to 70 deg. C., sodium-sulphate solutions of all concentrations at all temperatures, zinc-chloride solutions up to 5 per cent. concentration at 20 deg. C., and magnesium-chloride solutions up to 60 per cent. at 20 deg. C. Aluminium alloys which have been abandoned for certain uses in some branches of the chemical and textile industries will now be reconsidered because of the protection given by this coating. A property of the heat-treated and sodium-silicate-impregnated M.B.V. coating is its remarkable wear in contact with hydrogen peroxide.

Samples of M.B.V.-coated aluminium impregnated with sodium silicate were divided into two sections, one half heat-treated and the other untreated. These samples were placed in a 10 per cent. concentration of hydrogen peroxide for fourteen days, the hydrogen peroxide being renewed five times during this period. At the end of this time the untreated sheet had lost 1 grm. per sq. metre (0.03 oz. per sq. yd.) of surface, whereas the treated sheets retained their original weight. In the former case the hydrogen peroxide was discoloured pink, while in the latter case there was no coloration. It is justifiable to assume that with this remarkable protection against hydrogen peroxide and against hydrosulphurous acid, the film will be adequate in many other cases. If the practical introduction of the original M.B.V. process has opened up new fields of application for aluminium and aluminium alloys, it is possible that even more important fields will be found as a result of this secondary treatment.

An Interesting Lighting Development.

Controlled lighting, which can be focussed wherever desired, is, of course, the most economical and efficient, but hitherto it has been impossible to have this without the aid of independent reflectors. These are a considerable expense, are inconvenient, and waste labour; maintenance and periodical cleaning being required. Independent reflectors are also cumbrous, and light so controlled cannot be brought near to the object or machine which requires illuminating. The "Boula" Lamp, which is British made, has been designed to obviate these inefficiencies; at very little extra cost a thoroughly tested, accurately rated lamp is supplied, with a silver-mirror reflector permanently attached to the exterior surface of the bulb, and this is protected by a tough skin of copper. The patented process by which this reflector is applied is so efficient that the makers

The Boula Lamp in Use in the Drawing Office.

guarantee it not to peel off or blister under any conditions. The use of the "Boula" Lamp saves the cost of shades and reflectors, and double lighting power can be focussed on goods or work. The double-lighting shape has been designed to take advantage of the extra distribution of light obtained, and this shape, combined with the reflecting surface, has proved, through test at the National Physical Laboratories, to increase the lighting power to such an extent that a 60-watt "Boula" Lamp can efficiently take the place of an ordinary 100-watt lamp. For special purposes, such as for illuminating drawing boards, core benches, etc., the "Boula" Lamp can be supplied with its reflecting surface deposited at the top, bottom, side, obliquely, or patch shape, at no extra cost.

These lamps have considerable uses for shop, office, factory, workshop and garage lighting, and also in the home; and a great demand has been experienced for them since their appearance on the market. An interesting leaflet, showing the National Physical Laboratory's Report and Graph, can be obtained by our readers from the makers, the Boula Reflector Lamp Company, 156, Charing Cross Road, London, W.C.2, upon mention of this paper.

According to "Quality," the organ of the Sheffield Chamber of Commerce, the tonnage of steel being produced and worked up into finished goods in Sheffield is now 75 per cent. greater than 12 months ago.

Foundry Handling and Conveying.

(*Concluded from page 282.*)

commencement that plant was only doing one-quarter of that amount per day, but it was certainly looking to the future. That was a continuous plant using 2-ft. moulding boxes. The views shown of the plant using the small flaskless moulds, had six moulding machines, each producing 500 moulds per day. He did not know the weight of the castings.

Vote of Thanks.

Mr. Bigg, proposing a vote of thanks, said that on his recent visit to the Continent, mechanisation was conspicuous by its absence. He was surprised at that. That evening they had had a very instructive view of foundry mechanisation that could be nothing but helpful to all as to whether to mechanise or not; if so, how far. Without throwing bouquets at the manufacturers, he said, foundrymen could only expect them to supply the plant. The type of plant was the foundryman's responsibility. The fact that a plant was a success in one shop and a failure in another proved that. The salvation of the foundry came from within. Foundrymen were giving much thought to the question.

Mr. Goodwin, in seconding, said that what had been said and shown only went to indicate the march of progress. Mr. Spriggs had said there were two conveyors, Mr. Coggon had said three, but the real point was the human element. He would include in that vote of thanks Mr. Spriggs, Mr. Coggon and Mr. France, who had given the running commentary on the films. The vote was received with acclamation and Mr. Spriggs thanked the meeting.

Import Duties Advisory Committee.

The Import Duties Advisory Committee give notice of applications (1) for the addition of barytes to the Free List; (2) for a reduction in the import duty on magnet coils wound with aluminium wire adapted for use in electric hoists and separators. Any representations which interested parties may desire to make should be addressed in writing to the Secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, Westminster, London, S.W.1, not later than November 27, 1933.

The Advisory Committee also give notice of applications for an increase in the import duty on printing and bookbinding machinery, and for drawback under Section 9 of the Finance Act, 1932, in the case of graphite (plumbago) crucibles, and muffle rings, stands, stirrers and covers therefor, in respect of the natural flake graphite used in their manufacture. Any representations in regard to these two applications should be received by December 4.

The Committee announce that the application previously advertised for drawback under Section 9 of the Finance Act, 1932, in the case of metal cycle pumps, in respect of the uncoated drawn-steel barrels used in their manufacture, has now been withdrawn.

Basic Pig-Iron Prices Raised.

Rebate Scheme Introduced.

The Basic Pig-iron Producers' Association has increased prices in all districts by 7s. 6d. per ton. At the same time, a rebate scheme has been introduced, under which consumers who agree to take only British and Indian iron receive a rebate of 5s. per ton. The actual increase in this case is, therefore, 2s. 6d.

Delivered prices (subject to rebate) for the various districts are now as follow:—South Wales, 65s.; Scotland, 65s.; South Staffordshire, 70s.; Mersey, Lancashire, Cheshire, North Wales and North Staffordshire, 65s.; North-East Coast, 65s.; Sheffield district, 67s. 6d.

A Society for the Preservation of Old Sheffield Tools and Machinery has been formed. Mr. W. H. Bolton, of the Applied Science Department, Sheffield University, is the hon. secretary.

Sound Iron Castings.

MIDLAND EXPERTS EXAMINE EXISTING CONDITIONS.

Many aspects of the production of sound cast-iron castings were examined in the course of an open discussion in which members of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen took part on October 26, together with representatives of the other Midland Metallurgical Societies. The meeting was held at the James Watt Memorial Institute, Birmingham, under the chairmanship of Mr. W. A. Benton (President of the Birmingham Metallurgical Society).

The Chairman described the subject for consideration as one of perennial interest, and said it would be opened by Mr. A. Jude, M.I.Mech.E., Ex-President of the Birmingham Metallurgical Society.

An Engineer's View.

Mr. Jude, in the course of his observations, suggested that the modern foundry was incapable of producing with certainty sound iron castings. There were in general, he said, three kinds of internal defects: blow-holes, dirt and pull or contraction cavities. By far the most troublesome was pull.

Typical examples of defects were shown by lantern, the first series illustrating pulls. Commenting on what he called an obstinate case, Mr. Jude explained that the slide presented a thin semi-circular ring, about 16 in. in dia., on which there was a flange. The thickness was about an inch and a quarter. There was always a pull in one spot. It might be said: "Give us the complete ring and we will get it solid for you." His answer was the next slide. This represented a plain cylinder, cast with a head on as a rule—the sort of thing used for making piston rings. It was the most difficult matter in the world to get this sound. There were generally several spongy places in the casting which made it useless. The result was that his firm did not now make them as sand castings, but used centrifugal iron. Because the foundryman could not do it he had lost the job.

Mr. Jude showed what he described as a genuine sample of dirt, and, passing on to blow-holes, referred to a plain shaft coupling. It might be thought that this was an easy thing to make, he said, yet it was peppered with blow-holes. Why? They knew the effect could easily be produced by too low a pouring temperature, but that was by no means the only method. It could be produced with hot iron.

In conclusion, the speaker produced an air-compressor valve, seat and guard, consisting of a series of rings with arms running across it. In this instance, he stated, 99 per cent. of the castings were sound. They did not discover any fault while machining, nor did they find any fractures or hidden defects in practice.

The Chairman asked Mr. Jude if he could inform the meeting what type of irons he was referring to in his address.

Irons Used.

Mr. Jude replied that the irons averaged 12 tons tensile. For cylinders they used a rather harder grade running up to 14 or 16 tons. The 8-ton iron of twenty or thirty years ago had practically disappeared. He did not think anybody handled it nowadays except for firebox and similar products.

The Chairman: That throws some light on your difficulties. With these complicated castings, if you could use a freer-running iron you would get rid of some of your troubles.

Influences of Variables.

Mr. G. M. Callaghan said four things were necessary to produce good castings. In the first place they had to procure the necessary materials—iron and coke—which included the decision as to the desired analysis of the metal in the casting. Next was the change of those materials into a ladle of molten metal of the desired analysis, condition and temperature, ready for pouring into the mould. This involved all the technique which had as its centre the cupola or other furnace being used on the job, and even such things as blast pressure. In the opinion of eminent foundrymen even the humidity of the atmosphere affected the metal. A third consideration was how should the mould be made for the casting. Mr. Jude had alluded to this aspect of the problem when he mentioned that certain castings had been cast first with one side top and then with the other side top. They had to decide where was the best place for the runner or runners; what kind of riser should be employed; were any chills necessary; was a dry or a green sand mould desirable. Of course, they had to make their living out of the job and had to determine whether it should be machine-made or not. The fourth point was concerned with the actual preparation of the mould, and here they had to depend to a great extent upon the intelligence and skill of the men doing the job. The responsibility varied a great deal with the type of casting being made. On many repetition jobs very little skill was required, but in jobbing work the slightest error of judgment might be the cause of a casting having some slight defect. He thought that he had said enough to prove that there were many things to be watched if a good casting was to be produced.

More Grumbles.

Mr. G. W. Brown said he was not going to make any apology for the foundryman. He would yield to no one in his appreciation of the high skill and intelligence of foundrymen as a whole. At the same time, he had faults to find with the foundryman and the trade generally. In the firm with which he was at present connected they had found from long practical experience that it paid to try to keep the pouring temperature as constant as possible. Great progress had been made in the past ten years, and he believed that in the next decade a further stride forward would be made. The metal suppliers had helped the trade considerably. A firm could stipulate what they wanted and get it. Coke for use in the cupola could also be bought within very reasonable limits. By taking advantage of these advances foundrymen would have more reason to be proud of their productions. While foundrymen were highly skilled, they had plenty of room for developing their resources and knowledge in pursuing their daily occupation. The more they did so, the more would the mysterious elements disappear or shrink into little troubles which could be eliminated.

Teeming Speeds.

Mr. J. E. Hurst said a detail of procedure in the foundry which did not receive as much attention in England as it ought to receive—it was given a little more attention in America—was the question of control of the rate of pouring, or the total time involved in pouring a given mould. He suggested that rate of pouring was as important as casting temperature. If they went to the trouble of controlling casting temperature, he thought it was equally vital to control the rate, or amount, or volume of metal they introduced into a given space in a given time. This was done in all steel foundries engaged on the production of ingots. The only castings to escape Mr. Jude's scathing criticism were centrifugal castings. He (the speaker) would hate his brother foundrymen to imagine that there were never any defects in centrifugal castings. He assured them that it was quite possible to get defects even in castings made by the centrifugal process.

Scrap at One Per Cent.

Mr. J. W. Gardom contended that if the element of chance did not enter into the manufacture of castings, there would not be the good men in the trade that were in it to-day, because no good man played for safety. Speaking of the automobile trade, he said he had made castings for cars for ten years, and not 1 per cent. of failures had been returned by the manufacturers. That showed that there was control not only in the making of the castings, but in the inspection of them afterwards. Further, he had still to have a casting break on a car. As to the rate of pouring, that was done quite automatically by the fact that they definitely standardised the size of their ingates and methods of pouring. "I do not think any foundry running to-day is producing 5 per cent. of wasters," Mr. Gardom added, "and I know quite a lot of machine shops doing that."

Quantity and Quality.

Mr. F. J. Cook said such examples as had been shown by Mr. Jude were made in small numbers, the purchase being under the control of a buyer who did not consider whether the foundry making them was capable of doing the job satisfactorily or not. Mr. Jude also showed a casting the vast majority of which were good. That was a mass-production job. Wherever there was a job which had to be made in large quantities, the percentage of wasters was low. Any of the castings shown could be produced 98 per cent. good if they had to be produced in thousands.

Mr. Jude said his firm had made over 9,000 engines, the majority of which had two eccentrics and some three, so that the castings were not made in odd ones, although the numbers were small and could not be dealt with on mass-production lines.

Mr. G. T. Lunt, alluding to the question of prices, said it was the engineer who had to say what he wanted and accept the castings, but it was the buyer who purchased them and fixed the foundry price. If they were not willing to pay for castings a price which allowed the foundryman adequate time for experimenting, and which enabled him to get the right metals, they must expect having to run some risks in attempting to make a profit.

Mr. J. W. Jones said it was rather curious that from the moment the metal left the ladle and entered the mould, nature seemed to marshall her forces against the interest of the foundryman. What he desired, with certain exceptions, was a perfectly uniform casting. Nature would not have that for a second, for literally a second, the time interval, gave a temperature gradient from the centre to the outside, and where there was a temperature gradient there was a great deal of change in the mechanism of solidification. This caused structural change, and hence a final change in the properties.

Thermal Capacities of Steels and Slags.—Report No. 259 of the Steelworks Sub-Committee of the German Ironmasters' Association, by E. Schröder, published in the "Archiv für das Eisenhüttenwesen," describes a special calorimeter which the author has used for measuring the thermal capacities of various steels and slags; the different sources of error with this apparatus are also discussed. The readings obtained are shown graphically and compared with previous determinations. Following an analysis of the practical value and application of these measurements, the author advances suggestions for a works-type calorimeter suitable for industrial purposes. The specific heats of the steels and slags are not calculated.

This Week's News in Brief.

Trade Talk.

E. S. Lord, Limited, Grove Works, Harris Street, Rochdale, manufacturers of the "Eagle" core oils and compounds, announce change of name from Birchall & Lord, Limited, in order to avoid confusion with a firm of a similar name.

Messrs. Hurst Nelson & Company, Limited, Motherwell, have secured a share of an order for 500 12-ton open goods wagons for the L. & N.E. Railway Company, a part of the company's £2,300,000 programme recently announced.

The headquarters of the American Society for Testing Materials, which for the past fourteen years have been in the Philadelphia Engineers' Club building, will be moved at the end of this year to the Atlantic Building, 260, S. Broad Street, Philadelphia.

Mr. J. H. Thomas, M.P., Secretary of State for the Dominions, is to be the guest of honour of Messrs. R. A. Lister & Company, Limited, the well-known agricultural engineers, of Dursley, Glos, at their annual dinner, which takes place in the Café Royal on Wednesday, December 6.

Messrs. William Denny & Bros., Limited, Leven Works, Dumbarton, have obtained an order to build a Diesel-engined vessel for Messrs. MacBrayne & Company, Limited, Glasgow, for their Portree service. The vessel will be fitted for carrying passengers, and is expected to be ready for service in May or June, 1934.

The autumn meeting of the Refractory Materials Section of the Ceramic Society will be held from November 22 to 24 in the rooms of the Chemical Society, Burlington House, Piccadilly, London. As several Papers will be read of interest to the foundry industry, members of the Institute of British Foundrymen are invited to attend.

Ship repairing in Clyde yards continues to be fairly brisk. During the past week Messrs. D. & W. Henderson had nine vessels for repair and the Greenock Dockyard four vessels in dry dock. Messrs. Alexander Stephens, Linthouse, and the Blythswood Company, Limited, Scotstoun, each had several vessels for dry docking and overhaul and repairs.

Encouragement to a new branch of industry, that of the manufacture of high-pressure cylinders of steel to contain coal or coke-oven gas for the propulsion of omnibuses, was given by the Secretary for Mines, Mr. Ernest Brown, who opened yesterday (Wednesday) the first compressing station at the works of the Chesterfield Tube Company, Limited, Derbyshire.

Messrs. Ailsa Shipbuilding Company, Limited, of Troon and Ayr, have secured an order to build a passenger and cargo steamer for Bristol Channel owners. The vessel is to be built to Lloyd's highest class, and to meet Board of Trade requirements. The hull will be constructed at the Troon Shipyard, and the propelling machinery, consisting of triple-expansion engines, will be supplied from the firm's engineering department at Troon. This is the first work to be put in hand at the Troon yard since the launch of the cargo steamer "Sultan" in December, 1931.

The Williams Prize of the Iron and Steel Institute has this year been awarded by the Council jointly to Mr. D. F. Marshall, of Sheffield, for his Paper on "The External Heat Loss of a Blast Furnace," which was presented at the last annual meeting of the Institute in London, and to Mr. A. Robinson, of Scunthorpe, for his Paper on "Some Factors Leading to Greater Production from a Steel Furnace," which was presented at the autumn meeting of the Institute held in Sheffield in September last.

The Angleur-Athus Steel Company, Limited, the Semi-Steel Products Corporation of Belgium, Limited, Messrs. C. E. Faulkner, Limited, and Messrs. B. A. Daniel, Limited, have joined forces as from November 1 and are now trading as Ucometal Products, Limited, with offices at Dunster House, Mincing Lane, London, E.C.3. The company will be mainly concerned with the sale in this country of Continental semi-finished and finished steel products, and the purchase of British material for export to Belgium. The directors of Ucometal Products, Limited, are Messrs. H. A. Dubar, B. A. Daniel and C. E. Faulkner.

The Irish Sugar Company announced last week that contracts amounting to over £1,000,000 have been placed with foreign firms. Contracts for the supply of the chief items of manufacturing plant and equipment for the two new beet-sugar factories have been placed, it is understood, with R. Wolf-buckau, of Magdeburg, Germany, and the First Engine Works of Brno, Czecho-Slovakia. These two firms will work in co-operation, and in order to settle details of lay-out of factories their representatives will visit the sites this week. Pulp-drying plant at each factory will be supplied by the Buettner Werke Uerdingen, Germany.

"Princess Elizabeth" is the name which, by Royal permission, has been given to L.M.S. railway engine No. 6201, the second of the giant new locomotives built at Crewe Works for Anglo-Scottish express service. No. 6201, which is now in service, is a sister engine to the "Princess Royal" locomotive. The latter is now working very successfully on the Royal Scot express between Carlisle and London, running 3,600 miles each week. This type of engine is capable of working trains of 500 tons without assistance over the mountain summits of Shap and Beattock (the latter over 1,000 ft. above sea level), and is the most powerful class of express engine in Great Britain.

Plans for a steel plant in Kwangtung Province, China, are being prepared by Messrs. A. G. McKee & Company, engineers, of Cleveland, Ohio, according to the "Iron Age." A Chinese engineer representing the Mining Division of the Kwangtung Department of Construction is now in Cleveland co-operating with the McKee Company in designing the plant. The proposed construction will include one blast furnace with a daily capacity of 250 to 450 tons, provision being made for the erection of additional units, one battery of coke ovens, a combined blooming, rail and structural mill and a small hand mill for rolling merchant bars and small shapes. One of the products will be reinforcing bars, for which a considerable demand is said to have developed in China for use in road-construction work. A large amount of iron ore is available in the Kwangtung Province. The Government has finally confirmed the contract to the German Gutehoffnungshütte for the construction of an iron and steel plant near Pukow, China. Instead of 500,000 tons, as originally planned, the plant will produce only 250,000 tons annually—as the coal near Pukow is unsuitable for iron production and must be supplied by the far-distant Kao Kang mines of the An Yua district in Kiangsi. The total cost of the plant will be $40,000,000, and it is expected to start production in 1937. Construction work will begin during the current month.

Company Reports.

Brown, Bayley's Steel Works, Limited.—Profit, £2,251; brought in, £4,760; carried forward, £7,012.

Birmingham Small Arms Company, Limited.—Profit, £245,532; debenture interest and sinking fund contribution, £109,818; debit balance brought in, £220,608; debit balance carried forward, £84,895.

New Company.

Canward Foundry Company, Limited, Rainsford Road, Chelmsford.—Capital £3,000, to take over the business carried on at Chelmsford as the "Canward Foundry Company." Directors: W. H. Ward, E. B. Cook and Mrs. J. C. Ward.

Applications to Register Trade Marks.

The following list of applications to register trade marks is extracted from the "Trade Marks Journal":—

"Beacon Brand."—Graphite and manganese ores. Bush, Beach & Gent, Limited, Marlow House, Lloyds Avenue, London, E.C.3.

"Cromonard."—Metal goods. Ley's Malleable Castings Company, Limited, Vulcan Iron Works, Colombo Street, Derby.

Device, including letters "E.R.M.L."—Unwrought and partly-wrought metals. Enfield Rolling Mills, Limited, Lincoln House, 296-302, High Holborn, London, W.C.1.

Personal.

Mr. J. Paterson is retiring from the board of Messrs. Peter Stubs, Limited, Warrington and Rotherham.

Major J. M. Bevan, managing director of the Briton Ferry Steel Company, Limited, has left on a business trip to Canada.

Mr. Fred A. Smith has been elected general secretary of the Amalgamated Engineering Union, in succession to Mr. A. H. Smethurst.

Major A. C. Vivian, B.Sc., has been awarded a Telford Premium by the Institution of Civil Engineers for his work on the testing of cast iron.

Mr. William Smart, a well-known member of the Scottish Iron and Steel Trade Confederation, has been appointed Junior Bailie of Motherwell and Wishaw.

Mr. M. J. Railing, joint managing director of the General Electric Company, Limited, has been appointed vice-chairman in succession to Mr. E. G. Byng, who has resigned for reasons of health.

Mr. Wallace, who was until recently a director of Messrs. Cockburn & Company, Gowanbank Foundry, Falkirk, and has acted as Dean of Guild for the past year, was created a Bailie of Falkirk.

Mr. Arnold Walters has resigned his position as a director of Messrs. Christmas & Walters, Limited, with a view to trading on his own account as an engineer and contractor for the iron, steel and kindred trades.

Captain H. J. Kennard, managing director of Falkirk Iron Company, Limited, has been made a police judge consequent upon his re-election to the Falkirk Town Council. He has also been appointed convener of the Gas Committee.

Mr. and Mrs. Robert Thomson, of Radnor Park, Clydebank, have just celebrated their golden wedding. Mr. Thomson, who retired from work six years ago, served for 54 years with the Singer Sewing Machine Company, at Clydebank.

The staff of Messrs. Lithgows, Limited, Kingston Yard, Port Glasgow, have presented Mr. James Holmes with a wireless set and wallet of notes, with handbags for Mrs. and Miss Holmes, on the occasion of his retirement after 51 years' service with the firm.

Mr. R. E. Kennedy, technical secretary, American Foundrymen's Association, has been appointed the American representative on the Study Commission of the International Association for Testing Materials on Cast Iron. This Committee is under the chairmanship of Dr. F. Korber, of Germany.

British Pigirons, Limited, regret to state that Mr. E. C. O'Brien, who has been in their service for nearly eleven years, has had a very serious breakdown in health, and it is improbable that he will be able to resume his former duties. Mr. R. A. Martin, B.A.(Chem.), has been appointed in his place.

Mr. James Macfarlane, general manager of the Clyde Trust, has completed 50 years' service with the Trust. At lunch after the meeting of the body this week Mr. Macfarlane was presented with a silver tray, on which the signatures of the trustees were engraved, a silver tea and coffee service and a brooch for Mrs. Macfarlane.

Wills.

Layland-Barratt, Sir Francis, a director of the Hodbarrow Mining Company, Limited £519,548

Pye-Smith, Arnold, a director of Messrs. Samuel Osborn & Company, Limited, steel manufacturers, of Sheffield ... £44,543

Obituary.

Mr. George Grant, retired assistant manager of Rose Street Foundry, Inverness, has died at the age of 88.

Mr. James Marshall Aikman, works manager of the Vulcan Tube Works, Flemington, of Messrs. Stewarts and Lloyds, Limited, died on November 1. He was 37 years of age.

Mr. Walter H. Mills, a director of Messrs. Gjers, Mills & Company, Limited, proprietors of the Ayresome Ironworks, Middlesbrough, died on Saturday, November 4. He was 74 years of age.

The recreation and welfare club connected with the works of Messrs. J. G. Stein & Company, Limited, at Castlecary, held a whist drive in the works canteen on November 6. There was a large company present. Mr. John Miller acted as M.C., and the prizes were won by Mrs. Dalrymple and Mr. John Wilson.

Compare these actual test figures and you will realise the economies of the Buell system of pulverised fuel firing . . . .

The figures given in the Table at the right are certified representative test data of the operations of a forge reheating furnace after many months' operation under actual industrial conditions. The furnace in question was hand fired and steam blown before the adoption of pulverised coal. *Industrial executives are invited to write for further data to:*

The Buell Combustion Co. Ltd
49, MOORGATE, LONDON, E.C.2
Telephone: Metropolitan 7751.
Works EDGAR ALLEN & CO., LTD., Imperial Steel Works, Sheffield.

FORGE REHEATING FURNACE	HAND FIRING	BUELL PULVERISED FUEL SYSTEM
Calorific value of coal	13,500 B.T.U's	12,000 B.T.U's
COST PER TON DELIVERED	20/-	10/6
Working period per day	24 hours	24 hours
COAL CONSUMPTION PER HOUR	3-5 cwts.	2·4 cwts.
Period of reheating required	20 hours.	15 hours

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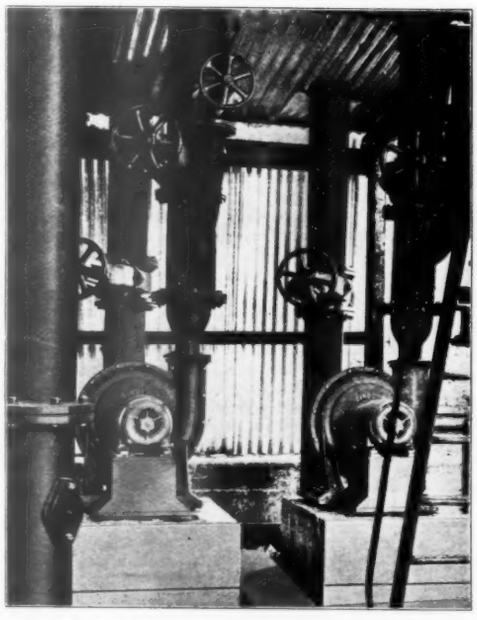


No. S.F. 26 dealing with "Sirocco" Fan Manufactures for moderate and high pressures. It includes some interesting examples of recent installations and contains detailed and accurate information concerning duties, weights and dimensions for the wide range of sizes and designs listed. In addition, numerous tables assist in determining the most suitable "Sirocco" Fan Equipment for use under diverse operating conditions.

A copy for reference is indispensable.

Write to

DAVIDSON & CO., LIMITED,
SIROCCO ENGINEERING WORKS, BELFAST.

LONDON : MANCHESTER : NEWCASTLE : BIRMINGHAM : CARDIFF : BRISTOL : GLASGOW : DUBLIN

Raw Material Markets.

The iron and steel market maintains its strength, home demands being particularly heavy in some sections. The export market is showing some expansion. Pig-iron traders are in a strong position. A consistent demand is forthcoming from consumers, and steps have had to be taken to increase the output. Stocks at the makers' works have, in general, been heavily reduced during the past few months. Foundry-iron prices continue firm, but unchanged. An increase of 7s. 6d. per ton has been made in the price of basic iron, but at the same time a rebate of 5s. is to be allowed to those consumers who agree to use only British or Indian iron.

Pig-Iron.

MIDDLESBROUGH.—The local producers of foundry iron are well booked up until the new year. New business has fallen away, industrial needs being already covered, but even so there are buyers who are eager to enter into further forward agreements, if only the makers were not reluctant to commit themselves heavily in the new year. An increase in prices may be seen if the costs of raw materials continue to increase. A few contracts have been accepted for the first quarter of next year at current rates, which for No. 3 Cleveland G.M.B. pig-iron are 62s. 6d. per ton delivered Middlesbrough, 64s. 6d. delivered North-East Coast, 62s. 3d. delivered Falkirk, and 65s. 3d. delivered Glasgow. The differences for other grades are No. 1 foundry iron, 2s. 6d. per ton premium; No. 4 foundry and No. 4 forge iron, 1s. per ton discount.

It is reported that stocks of East Coast hematite at most of the works have all been sold, and that the output of the furnaces is fully sold to the end of December. Further contracts are understood to be in abeyance owing to the consideration by the makers of another increase in prices. The present nominal quotations are 62s. 6d. per ton for mixed numbers and 63s. for No. 1 grade, f.o.t. makers' works, or 2s. 6d. per ton less for abroad. This preference to foreign consumers is arousing some comment.

LANCASHIRE.—A fair amount of forward buying, covering the early months of next year, has been seen, whilst satisfactory deliveries against running contracts continue to be made. Textile-machinery manufacturers are rather more active. General engineers are also somewhat better placed. Quotations are firm generally, with Derbyshire and Staffordshire No. 3 foundry iron on offer for delivery to consumers in the Manchester price zone at 67s. per ton, Northants at 65s. 6d., Derbyshire forge iron at 62s., Scottish foundry at around 80s., East Coast hematite at about 76s. and West Coast hematite at 80s. 6d.

MIDLANDS.—There continues to be a good demand for foundry iron and, if the present rate of deliveries is continued, the total despatches of iron to consumers during this month should be better than during October. The light-castings makers are still very busy. The general and heavy engineering trades are not well placed for work, although there has been a further increase in the production of castings for motor work. Up to the present, no trouble has been experienced in getting immediate supplies of ordinary grades of foundry pig-iron. Prices are unaltered at 62s. 6d. for No. 3 Northants and 66s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, which figures are subject to rebate to consumers of large tonnages. In connection with special grades of iron, refined pig for Diesel-engine and other high-class work is quoted from £5 15s. to £6 15s., medium-phosphorus iron from 70s. to 80s., and low-phosphorus pig from 80s. to 90s. per ton, delivered to this district. No. 3 Scottish pig-iron, of which a limited amount is consumed in certain local foundries, is quoted in the region of 85s. per ton. Continental pig-iron is not competitive in this market, and only small occasional lots of Cleveland iron are coming through at the present price of 72s. 6d.

SCOTLAND.—The demand for foundry iron in Scotland is poor, and at many foundries the consumption of iron has fallen away considerably, that is, with the exception of those engaged in the light-castings trade, particularly in the Falkirk area. The furnaces find it difficult to dispose of their make and are having to put metal into stock. There is no change to record in prices, and the official minimum of 65s. f.o.t. furnaces for No. 3 is still in force, with 2s. 6d. per ton additional for No. 1. There is no change in Middlesbrough prices, viz., 62s. 3d. f.o.t. Falkirk and 65s. 3d. f.o.t. Glasgow, with other English iron being offered at 1s. 3d. per ton less.

Coke.

The prices of foundry cokes still remain unchanged, although an increase has been expected for some time, in view of the higher quotations for blast-furnace grades. Delivered to stations in the South Staffordshire area, best Durham coke is at 36s. to 38s., Scottish coke at 38s. 6d. to 40s. and Welsh at 31s. to 45s.

Steel.

Business continues on a satisfactory scale, the weak spot in the position being the comparatively poor export demand, which is affected by exchange fluctuations and the various restrictions imposed by foreign Governments, states the official report of the London Iron and Steel Exchange. The volume of export inquiry has been on a good scale, but only a small proportion of this develops into actual business. Nevertheless, it indicates that the requirements of overseas markets are increasing. Business in semi-finished steel has not been so good, but this is probably because users have bought forward, and few of the British makers are able to give delivery before the end of the year. Business in Continental semis has been increasing, but is insignificant compared with the quantities formerly brought into the country. The situation in the finished-steel department is improving, but business is principally on home account. Prices of uncontrolled materials have advanced somewhat of late, but competition from the Continent has become rather more noticeable in several districts.

Scrap.

A scarcity of some classes of cast-iron scrap continues to be felt in some areas. This is particularly the case in the Cleveland district, where ordinary heavy is now at 47s. 6d. and machinery quality at 49s., light metal, which is in good demand, being at 43s. 6d. There remains a steady demand in the Midlands and prices are firm. Business continues to be backward in South Wales and in Scotland, owing to the somewhat slack demand from the foundries in those areas.

Metals.

Copper.—Business in electro in Europe has been irregular lately owing to lack of demand from consumers. The weakness in the market has again been contributed to by the uncertainty of the American situation. The dollar continues to fluctuate, and the U.S. copper interests have failed to agree upon the code proposed by the N.R.A. administration. Unless the dollar is "pegged," it is impossible to say how far the sterling price of copper will fall. At all events, it seems that consumers can assure themselves of cheaper supplies for some time to come. Empire producers may press for the imposition of the duty on foreign metal.

The week's prices have been as follow :—

Cash.—Thursday, £31 16s. 3d. to £31 17s. 6d.; Friday, £31 13s. 9d. to £31 16s. 3d.; Monday, £31 13s. 9d. to £31 16s. 3d.; Tuesday, £31 5s. to £31 6s. 3d.; Wednesday, £29 7s. 6d. to £29 8s. 9d.

Three Months.—Thursday, £31 17s. 6d. to £32; Friday, £31 17s. 6d. to £31 18s. 9d.; Monday, £31 17s. 6d. to £32; Tuesday, £31 7s. 6d. to £31 8s. 9d.; Wednesday, £29 11s. 3d. to £29 12s. 6d.

Tin.—The firmness of the market and the higher prices have had a stimulating effect on trade demand, and a more active business has been reported both in America and on the Continent. In the U.S.A. the firm tone is ascribed in a measure to purchases which have been made in anticipation of the possibility of further depreciation of the dollar in the near future, report Messrs. Rudolf Wolff & Company. On the London market the reticence of sellers and the scarcity of tin for near deliveries have caused some apprehension and occasioned some fairly substantial bear covering. The future of this metal is still favourably regarded, and though the present price is high, there would seem to be a probability of even further advance.

Daily quotations :—

Cash.—Thursday, £230 to £230 5s.; Friday, £229 5s. to £229 10s.; Monday, £229 17s. 6d. to £230; Tuesday, £229 15s. to £229 17s. 6d.; Wednesday, £226 15s. to £227.

Three Months.—Thursday, £228 15s. to £229; Friday, £228 7s. 6d. to £228 10s.; Monday, £228 15s. to £229; Tuesday, £228 15s. to £228 17s. 6d.; Wednesday, £226 5s. to £226 10s.

Spelter.—The galvanising trade in this country is not too well placed as regards current and forward orders, and the outlook for spelter consumption is rather uncertain. The slight improvement in the engineering industry here has not been enough to affect the demand for high-grade metal. The London market has had an easier tone just recently. In view of these circumstances, the proposals for reducing the output of spelter are attracting considerable attention. A meeting of the Cartel is to be called to discuss the matter.

Price fluctuations :—

Ordinary.—Thursday, £15 17s. 6d.; Friday, £15 13s. 9d.; Monday, £15 5s.; Tuesday, £15; Wednesday, £14 10s.

Lead.—Supplies of lead are plentiful and the effect of a reduction in output from one or other of the larger producers should not be seriously felt at the present time. On the contrary, the fall in the value of the Canadian dollar should make production in that country more profitable. As far as consumption is concerned, most of the works in England are fairly well covered and are not anxious to buy for further ahead. On the Continent the demand has also not been quite so good, which is partly due to seasonal slackness in some lines at this time of the year. The American price has remained unchanged at 4.30 cents in spite of the fall in the dollar, report Messrs. Brandeis, Goldschmidt.

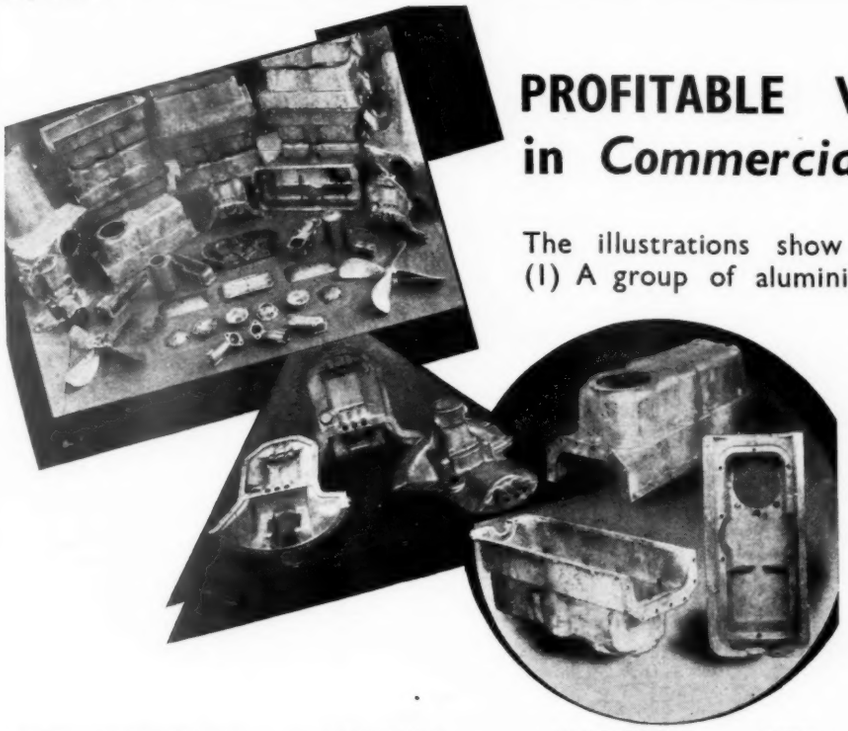
Daily market prices :—

Soft Foreign (Prompt).—Thursday, £12; Friday, £11 17s. 6d.; Monday, £11 13s. 9d.; Tuesday, £11 10s.; Wednesday, £11.

Decarburisation of Steel.—Mr. C. R. Austin, in a Paper, on "A Study of the Effect of Water Vapour on the Surface Decarburisation of Steel by Hydrogen with Certain Developments in Gas Purification," read recently before the American Society for Steel Treating, sets forth data obtained under experimental conditions more refined than hitherto and outlines the method adopted for the preparation of "pure hydrogen." It is demonstrated by chemical and metallographic analyses that the pure gas has a definite but extremely-limited decarburising power at 860 deg. C. on eutectoid steels, and that as the water-vapour content of moist hydrogen gas is increased (except in very low concentration) the decarburising power of the gas is also profoundly increased.

Experimental Steel-Road Surfaces.—Recently a 100-metre experimental section of a steel-surfaced highway was opened to traffic in Germany. The steel surface consists of zigzag-shaped, high-edged grate rods running crosswise of the road, prepared in the factory in sections 6 metres long and 1 metre wide. The sections are solidly anchored and fastened together with bolts or by welding, and the voids are filled with Macadamised tar, which ensures a level surface not subject to waves or depressions as normal traffic presses the tarred gravel into the grating. The metal sections are laid on a basaltic-gravel foundation, and rest on a longitudinal, wide base to which they are welded or bolted. Rubber tyres apparently do not suck out the filling material, but with constant friction the surface becomes somewhat worn, so that the ribs of the plates protrude from 3 to 5 mm. It has been estimated that a highway 18 metres wide and 1 kilometre in length would require 500 tons of steel. Similar experiments with steel and iron for paving streets that carry extremely heavy traffic, bridges, wharves and factory floors, have been initiated in other countries. In the United States, in 1931, a bridge floor in Seattle, Wash., was surfaced with a steel open-mesh mat in fabricated sections filled with asphaltic material. Experiments in the use of steel and iron in surfacing roads are being carried on in other European countries, but to date the expense of such pavements has prevented their general adoption for any but heaviest-traffic areas in industrial sections.

F.T.J. 16-11 33



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MELTING FURNACES, ANNEALING OVENS, CORE STOVES, Etc.

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UNIT PULVERISERS
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RAW MATERIALS—PRICE LIST.

(Wednesday, November 15, 1933.)

COPPER.

	£	s.	d.
Standard cash	29	7	6
Three months	29	11	3
Electrolytic	33	0	0
Tough	31	0	0
Best selected	31	10	0
Sheets	62	0	0
India	41	0	0
Wire bars	33	0	0
Ingot bars	33	0	0
H.C. wire rods	34	15	0
Off. av. cash, October	33	13	$10\frac{31}{44}$
Do., 3 mths., October	33	17	$2\frac{1}{44}$
Do., Sttlmnt., October	33	14	$1\frac{1}{11}$
Do., Electro, October	37	7	$0\frac{6}{11}$
Do., B.S., October	36	6	$4\frac{3}{4}$
Do., wire bars, October	37	14	$6\frac{9}{11}$
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			7d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	$8\frac{1}{2}$d.
Rods, extd. or rlld.	$4\frac{1}{2}$d.
Sheets to 10 w.g.	$7\frac{1}{2}$d.
Wire	$7\frac{1}{2}$d.
Rolled metal	7d.
Yellow metal rods	$4\frac{1}{2}$d.
Do. 4 × 4 Squares	$5\frac{3}{4}$d.
Do. 4 × 3 Sheets	$5\frac{3}{4}$d.

TIN.

	£	s.	d.
Standard cash	226	15	0
Three months	226	5	0
English	227	5	0
Bars	228	15	0
Straits	230	15	0
Australian (nom.)	—		
Eastern	229	10	0
Banca	230	15	0
Off. av. cash, October	223	10	$7\frac{1}{2}$
Do., 3 mths., October	223	8	$11\frac{1}{2\frac{1}{2}}$
Do., Sttlmt., October	223	10	$10\frac{10}{11}$

SPELTER.

	£	s.	d.
Ordinary	14	10	0
Remelted	15	0	0
Hard	12	5	0
Electro 99.9	17	0	0
English	15	5	0
India	14	5	0
Zinc dust	20	0	0
Zinc ashes	3	10	0
Off. aver., October	16	9	$1\frac{1}{11}$
Aver. spot, October	16	6	$2\frac{7}{8\frac{1}{2}}$

LEAD.

	£	s.	d.
Soft foreign ppt.	11	0	0
Empire	11	5	0
English	12	10	0
Off. average, October	11	19	$0\frac{3}{4}$
Average spot, October	11	16	$0\frac{3}{2\frac{1}{2}}$

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	25	10	0
Do., V.M. ex whse.	24	0	0
Rods	29	0	0

ANTIMONY.

	£	s.	d.		£	s.	d.
English	37	10	0	to 40	0	0	
Chinese, ex-whse.					26	15	0
Crude					20	10	0

QUICKSILVER.

	£	s.	d.		£	s.	d.
Quicksilver	9	10	0	to 10	0	0	

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	6 10 0
45/50%	12 10 0
75%	18 2 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	2/6 lb.
Tungsten metal powder—	
98/99%	2/9 lb.
Ferro-chrome—	
2/4% car.	32 0 0
4/6% car.	23 0 0
6/8% car.	21 2 6
8/10% car.	21 2 6
Ferro-chrome—	
Max. 2% car.	34 10 0
Max. 1% car.	35 12 6
Max. 0.70% car.	37 10 0
70%, carbon-free	$10\frac{1}{2}$d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt, 98/99%	5/6 lb.
Metallic chromium—	
96/98%	2/8 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under $\frac{1}{2}$ in. to $\frac{1}{4}$ in.	3d. lb.
Do., under $\frac{1}{4}$ in. to $\frac{5}{16}$ in.	1/- lb.
Flats, $\frac{1}{2}$ in. × $\frac{1}{4}$ in. to under 1 in. × $\frac{3}{8}$ in.	3d. lb.
Do., under $\frac{1}{2}$ in. × $\frac{1}{4}$ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					2	10	0
Bundled steel and shrngs.	2	3	6	to 2	9	0	
Mixed iron and steel	2	5	0	to 2	6	6	
Heavy cast iron	2	5	0	to 2	6	6	
Good machinery					2	7	6
Cleveland—							
Heavy steel	2	7	6	to 2	10	0	
Steel turnings					1	11	6
Cast-iron borings					1	2	0
Heavy forge					2	10	0
W.I. piling scrap					2	5	0
Cast-iron scrap	2	7	6	to 2	9	0	
Midlands—							
Light cast-iron scrap					2	0	0
Heavy wrought iron					2	10	0
Steel turnings, f.o.r.					1	8	0
Scotland—							
Heavy steel	2	6	6	to 2	7	6	
Ordinary cast iron					2	7	6
Engineers' turnings					1	15	0
Cast-iron borings					1	15	0
Wrought-iron piling					2	8	6
Heavy machinery	2	10	0	to 2	11	6	

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	26	0	0
Brass	19	0	0
Lead (less usual draft)	10	15	0
Tea lead	8	0	0
Zinc	10	10	0
New altminium cuttings	73	0	0
Braziery copper	24	0	0
Gunmetal	25	0	0
Hollow pewter	145	0	0
Shaped black pewter	105	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/-
Foundry No. 3	62/6
,, at Falkirk	62/3
,, at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	63/-
Hematite M/Nos., f.o.t.	62/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	68/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/-
,, No. 3 fdry.	66/-
Northants forge	58/6
,, fdry. No. 3	62/6
,, fdry. No. 1	65/6
Derbyshire forge	62/-
,, fdry. No. 3	66/-
,, fdry. No. 1	69/-
Scotland—	
Foundry No. 1	**67/6**
,, No. 3	65/-
Hem. M/Nos. d/d	66/-
Sheffield (d/d district)—	
Derby forge	59/6
,, fdry. No. 3	63/6
Lincs forge	59/6
,, fdry. No. 3	63/6
E.C. hematite	76/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	80/-
Clyde, No. 3	80/-
Monkland, No. 3	80/-
Summerlee, No. 3	80/-
Eglinton, No. 3	80/-
Gartsherrie, No. 3	80/-
Shotts, No. 3	80/-

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	0	0	to 9	15	0	
Nut and bolt iron	6	17	6	to 7	10	0	
Hoops	10	10	0	to 12	0	0	
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to 12	0	0	
Bolts and nuts, $\frac{3}{4}$ in. × 4 in.					13	10	0
Steel—							
Plates, ship, etc.	8	15	0	to 8	17	6	
Boiler plts.					8	5	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to $5\frac{1}{2}$ in.					9	7	6
Rounds under 3 in. to $\frac{3}{8}$ in. (Untested)					7	2	6 & up.
Flats—8 in. wide and over					8	12	6
,, under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to 8	10	0	
Fishplates					12	0	0
Hoops (Staffs)	10	10	0	& up.			
Black sheets, 24g. (4-t. lots)					10	5	0
Galv. cor. shts. (,,)					12	15	0
Galv. flat shts. (,,)					13	5	0
Galv. fencing wire, 8g. plain					14	0	0
Billets, soft	5	10	0	to 5	15	0	
Billets, hard	6	17	6	to 7	2	6	
Sheet bars	5	0	0	to 5	7	6	
Tin bars					5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	$11\frac{1}{2}$d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	18.26
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	13.50
Basic	18.89
Bessemer	19.76
Malleable	19.39
Grey forge	19.39
Ferro-mang. 80%, seaboard	82.00
O.-h. rails, h'y, at mill	37.75
Billets	26.00
Sheet bars	26.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	1.74
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.60
Steel hoops	1.85
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.10
Plain wire	2.10
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.65

COKE (at ovens).

Welsh foundry	22/6 to 25/-
,, furnace	16/- to 19/-
Durham foundry	21/- to 25/-
,, furnace	15/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		16/9 to 17/-
,,	28×20	,,	33/6 to 34/-
,,	20×10	,,	24/1½ to 24/6
,,	18¾×14	,,	17/7½ to 17/9
C.W.	20×14	,,	15/3 to 15/9
,,	28×20	,,	32/6 to 32/9
,,	20×10	,,	22/9 to 23/-
,,	18⅞×14	,,	15/9 to 16/-

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.		£	s.	d.
Pig-iron	£6	0	0	to £7	0	0	
Bars-hammered, basis	£16	0	0	to £16	10	0	
Bars and nail-rods, rolled, basis	£15	15	0	to £16	0	0	
Blooms	£10	0	0	to £12	0	0	
Keg steel	£30	0	0	to £31	0	0	
Faggot steel	£18	0	0	to £23	0	0	
Bars and rods dead soft, st'l	£10	0	0	to £12	0	0	

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Nov.	9 ..	31	16	3	dec.	1/3
,,	10 ..	31	13	9	,,	2/6
,,	13 ..	31	13	9	No	change
,,	14 ..	31	5	0	dec.	8/9
,,	15 ..	29	7	6	,,	37/6

Electrolytic Copper.

		£	s.	d.		
Nov.	9 ..	35	0	0	dec.	10/–
,,	10 ..	35	0	0	No	change
,,	13 ..	35	0	0	,,	,,
,,	14 ..	34	10	0	dec.	10/–
,,	15 ..	33	0	0	,,	30/–

Standard Tin (cash).

		£	s.	d.		
Nov.	9 ..	230	0	0	inc.	65/–
,,	10 ..	229	5	0	dec.	15/–
,,	13 ..	229	17	6	inc.	12/6
,,	14 ..	229	15	0	dec.	2/6
,,	15 ..	226	15	0	,,	60/–

Tin (English ingots).

		£	s.	d.		
Nov.	9 ..	230	10	0	inc.	65/–
,,	10 ..	230	0	0	dec.	10/–
,,	13 ..	230	10	0	inc.	10/–
,,	14 ..	230	5	0	dec.	5/–
,,	15 ..	227	5	0	,,	60/–

Spelter (ordinary).

		£	s.	d.		
Nov.	9 ..	15	17	6	inc.	2/6
,,	10 ..	15	13	9	dec.	3/9
,,	13 ..	15	5	0	,,	8/9
,,	14 ..	15	0	0	,,	5/–
,,	15 ..	14	10	0	,,	10/–

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Nov.	9 ..	18	2	6	inc.	2/6
,,	10 ..	18	0	0	dec.	2/6
,,	13 ..	17	15	0	,,	5/–
,,	14 ..	17	10	0	,,	5/–
,,	15 ..	17	0	0	,,	10/–

Zinc Sheets (English).

		£	s.	d.		
Nov.	9 ..	25	10	0	No	change
,,	10 ..	25	10	0	,,	,,
,,	13 ..	25	10	0	,,	,,
,,	14 ..	25	10	0	,,	,,
,,	15 ..	25	10	0	,,	,,

Lead (English).

		£	s.	d.		
Nov.	9 ..	13	10	0	inc.	5/–
,,	10 ..	13	5	0	dec.	5/–
,,	13 ..	13	5	0	No	change
,,	14 ..	13	0	0	dec.	5/–
,,	15 ..	12	10	0	,,	10/–

Imports and Exports of Iron and Steel Castings, etc., in October and the ten months 1933, compared with October and the ten months 1932.

	October, 1932.	October, 1933.	Ten months, 1932.	Ten months, 1933.	October, 1932.	October, 1933.	Ten months, 1932.	Ten months, 1933.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	164	67	2,399	1,045	2,883	2,399	42,131	21,937
Castings, in the Rough, Iron	9	46	550	113	181	986	9,937	3,315
,, ,, ,, Steel	77	56	1,456	476	1,143	913	28,419	8,278
Hollow-ware, Cast, not Enamelled	1	4	45	43	67	224	2,923	2,459
,, ,, Enamelled	3	9	199	96	77	381	5,530	5,229
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	5	2	286	81	179	152	10,624	3,690
,, Irish Free State	223	441	2,930	3,151	9,820	19,534	132,283	133,206
,, British South Africa	152	361	1,244	2,036	5,346	11,199	44,339	78,703
,, ,, India	58	78	687	853	3,400	4,363	25,643	30,175
,, New Zealand	22	24	283	228	1,156	1,656	14,945	13,203
Total (including other countries)	791	1,425	8,682	10,413	35,385	59,673	366,343	426,300
PIPES AND FITTINGS—CAST—								
To Argentine Republic	155	73	1,462	1,231	1,735	921	15,780	14,326
,, Irish Free State	537	756	5,565	5,786	5,948	10,488	75,782	76,049
,, British South Africa	191	799	3,158	7,951	1,968	8,858	39,455	72,871
,, ,, India	49	346	928	1,239	629	5,132	14,970	19,045
,, ,, Malaya	285	163	2,157	665	2,119	3,040	21,520	8,131
Total (including other countries)	4,475	9,081	55,484	67,876	48,351	94,307	563,008	657,130
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	250	424	2,013	2,904	8,513	12,653	70,409	89,996
,, Enamelled	61	69	666	615	5,369	5,249	56,407	48,755
CASTINGS, in the rough—								
Iron	94	100	832	890	3,421	3,307	31,385	31,004
Steel	37	72	612	842	2,048	2,932	26,425	33,262

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

REGISTERED TRADE MARK
LUMPEX
TN

ORANGE SHELLAC
for Loose & Repetition Patterns.

WILLIAM JACKS & COMPANY,
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.
ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

BRASS-FOUNDRY Manager shortly open to engagement; expert on metals and alloys; can show excellent results.—Write, Box 552, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FIRST-CLASS Practical Moulder, age 27, experienced on general engineering castings, pipe-founding, plate and machine moulding, with good technical training, desires position as Assistant Foundry Foreman or Foreman.—Box 544, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

METALLURGICAL CHEMIST requires position, having had 6 years' experience in the production of malleable and grey iron castings.—Box 542, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THE NATIONAL STEEL FOUNDRY (1914), LIMITED, Kirkland Works, Leven, Fife, require a Foundry Foreman capable of producing up to 100 tons of light and medium-weight Steel Castings per week in green and dry sand. Must be thoroughly acquainted with machine-moulding practice, capable of fixing piecework prices, good organiser and strict disciplinarian. State age, experience, and salary expected.

WANTED, Foreman for small foundry in the South. Light castings, iron and non-ferrous. Must be conversant with machine-moulding practices, strict disciplinarian, and able to produce results. Only men experienced in producing very competitive lines need apply.—Box 554, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

STEEL Foundry Manager or Foreman requires situation. Experience includes converter, open-hearth and electric furnaces, plain carbon and alloy steels. Used to high-class work with well-known firms; locomotive, marine and hydraulic castings. (232)

METALLURGICAL Engineer desires Technical or Production post; many years' experience in control of production, technical and commercial. All metals, specialised experience nickel alloys, magnetic and heat-resisting metals, high-frequency furnaces. Sound general administrative ability. (233)

PUBLICATION.

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. A new edition will be going to press soon. *Write now* for full particulars and advertisement rates.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

FOR Sale, small Ironfoundry as Going Concern. Scope for development; situated in industrial area and the only one in the district. A good, sound investment for practical man. Near Sheffield and Manchester.—Box 558, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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11 ACRES WORKS SITE.
SHEFFIELD.
145,000 Sq. Ft. of Shops.
SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.
WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—
THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

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FOR IMMEDIATE CLEARANCE.

SAND MILL with 5-ft. dia. under-driven revolving pan, rollers 30 in. dia. x 10 in. Price £12.

Macdonald Pneumatic Jolt Turnover Moulding Machines, 46 x 36, with carriage. £28.

Keith Blackman Electric Cast-iron-cased Blower, 7-in. outlet, 460 volts D.C.; revs., 2,280/2,840, with Brookhirst Starting Panel. £25.

No. 2 Darling & Sellers Hand Ram Turnover Moulding Machines, Table 2 ft. 6 in. x 1 ft. 8 in. Price £11.

All above as standing at works, Derby.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.,
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.
Rotoil "Senior" Oil Core Sand Mixer.
Pneulec Sand Drying Plant, output 1 ton per hour.
Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.
Also
Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.
Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

AIR COMPRESSORS

All sizes for high and low pressures.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD, LTD.

PUMPING SET, 3", Petrol-dr., Port. Diap., cap. 4,500 galls. per hr.
125-b.h.p. MOTOR, Slipring, 450 v., 2-ph., 50 cyc., 580 revs.
SINKING PUMP, "Evans" Vert. "Cornish" D.A., cap. 20,400 g.p.h. at 100 ft. per min.
Nearly New High-class Steam Tractor
Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued.*

FOR Sale, in good condition, Secondhand Moulding Machines, all types and sizes. Sand Mills, Sand Mixers, Core Ovens. I can supply your requirements for all foundry equipment.—Box 548. Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS.

CHILLED CASTINGS.

COMPANY desires working arrangement with foundry prepared to make CHILLED CASTINGS (including Rolls). Technical assistance given.—Write, MCH, Box 556, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOR Sale, 300 gross of Moulders' Hardwood Wedges, 2s. 9d. per gross; carriage paid on 20-gross lots.—J. R. DENISON, Commercial Street, Farsley, Leeds.

'Phone: 287 SLOUGH

PNEUMATIC MACHINES

Two "Osborn" Jolt strip machines 32" × 20" **£75** each.
Two "Tabor" 18"×36" portable rollover jolters **£60** each.
One "Tabor" 24"×48" portable rollover jolter **£90**
30"×20" Macdonald rollover jolter **£60**
20"×16" Macdonald rollover jolter **£40**
8 Ton Macdonald plain jolter, 20" cylinder .. **£160**

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1 **£30**
Herbert "Whizzer" type disintegrator, No. 2 **£46**
Rotary sand mixer and elevator **£24**
Gyratory sand riddle with motor **£7**
Large "Baillott" sand preparing plant CHEAP.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

FOR SCOTTISH IRONFOUNDERS.

FOUNDRY COKE
SPLINT COAL
SMITHY COAL

also

Hard Firewood for Kindling Purposes (in cut lengths 2' to 3') for Furnaces.

FOR QUOTATIONS—
Estab. 1870. **JOHN KNOX & Co.,** Telephone: Doug. 3506
Pinkston, Port Dundas, GLASGOW, C.4.

TONS OF

COLBOND

are used daily in British foundries.

THE MEANING?

COLBOND added to floor sand, silica sand, or a mixture of both, DEFINITELY DOES improve castings and cheapen production.

Send for 5 cwts. and with our co-operation prove it.

Particulars from:

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